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ON THE TRANSFORMATIONS OF THE RED MITES.[1]

BY PROF. C. V. RILEY.

The Locust Mite (*Trombidium locustarum* Riley).—One of the most interesting as well as one of the most important of our locust enemies is what we may popularly call the Locust Mite. It forms a true link between those articulates which prey on the eggs and those which prey on the locusts, since it combines both traits. Referred to in previous writings under the name of the silky mite, its natural history was first fully made out by the writer during the past summer. It differs so much in infancy and maturity that it has been referred to distinct genera, and was always known under two different names. During either period it proves a bitter enemy to the locust. In the mature form it lives in the ground, feeding upon all sorts of soft animal and decomposing vegetable matter. When the locust fills the ground with its eggs this mite flourishes upon the abundance of food which these afford, sometimes teeming to such an extent as to give the ground a scarlet hue. How numerous and how beneficial to man as a locust-egg destroyer this mite may be, is well illustrated by the statements in the Appendix.[2] In spring the female lays between 300 and 400 minute spherical, orange-red eggs in the ground. (Fig. 1*a*.) From these eggs in due time there hatch little orange mites (Fig. 1*b*), which differ from the parent in having but six legs. This six-legged form belongs to Latreille's genus *Astoma*, erected when naturalists had no suspicion that it was purely a larval form. The specific name

[1] Extracted from advance copy for the First Annual Report of the U. S. Entomological Commission.

[2] These details are here omitted.

locustarum was first proposed for it by B. D. Walsh,[1] but Dr. Le Baron afterwards gave it the name of *Atoma gryllaria*,[2] in connection with a detailed description.

Active when they first hatch and impelled by instinct, these

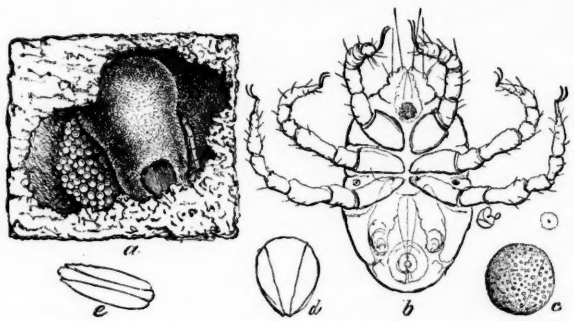

Fig. 1.—*Trombidium locustarum* :—*a*, female with her batch of eggs (after Emerton); *b*, newly hatched larva—natural size indicated by the dot within the circle; *c*, egg; *d*, *e*, vacated egg-shells (after Riley).

little six-legged specks crawl upon the locusts and fasten to them, mostly at the base of the wings or along their principal veins, just as a tick fastens to a dog, or a sheep, or to man. Thus attached to their victim they suck its juices and swell until the legs become invisible. It is in this condition (Fig. 2*a*) that they

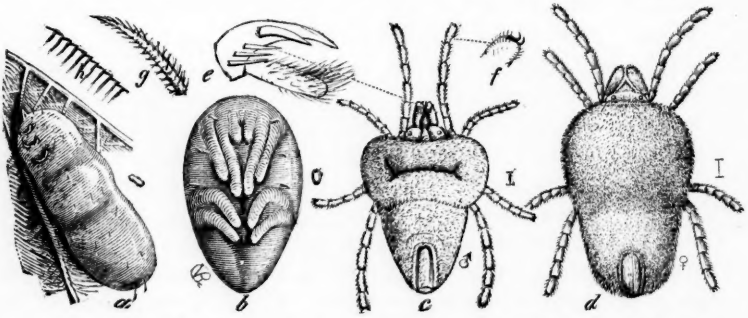

Fig. 2.—*Trombidium locustarum* :—*a*, mature larva when about to leave the wing of a locust; *b*, pupa; *c*, male adult when just from the pupa; *d*, female—the natural sizes indicated to the right; *e*, palpal claw and thumb; *f*, pedal claws; *g*, one of the barbed hairs; *h*, the striations on the larval skin. (*d*, after Emerton.)

[1] Practical Entomologist, 1, p. 126.

[2] Le Baron's Second Illinois Ent. Report., 1872, p. 156. The author employs the term *Atoma*, which, though at first employed by Latreille, is corrected to *Astoma* in his Genera Crustaceorum et Insectorum, 1, p. 162 (1806).

are most often noticed, presenting to the ordinary observer the appearance of a bright red oblong-ovoid body growing from the wing. They are so firmly attached by the mouth, so immovable, and with the legs so short and hidden, that persons unfamiliar with their true nature might easily mistake them for some natural growth or excrescence. That they are often so numerous as to weaken and kill their victim, reports clearly prove.

In due time these swollen bodies let go their hold and drop to the ground where, clumsily and with difficulty, they crawl under the first shelter afforded by some bit of loose earth, or a stone. Here they remain quiet for two or three weeks, gradually swelling and changing form. During this change the pupa state is assumed, but not by shedding any skin as do true insects in going through their transformations. New legs, feelers and mouth-parts form under the old skin, which, with its now useless legs, distends so as barely to cover the new parts, which are all appressed to the body very much as in the pupa of a beetle. (Fig. 2*b*.) Finally both the distended larval skin and the new one that incases the pupa burst, and release a creature quite different from the former Astoma—in fact, none other than the 8-legged Trombidium. (Fig. 2*c*.) We thus see that from the time this mite hatches, through all its growth and changes, but one molt takes place. The mature form passes the winter in the ground, and is active whenever the temperature is a few degrees above freezing point.

Only two species of the genus Trombidium have been described in America, viz: *scabrum* Say, and *sericeum* Say.[1] The descriptions in both cases are brief, and lacking in structural details and in measurements. The locust mite under consideration has been hitherto referred to *sericeum*, but the characteristic polished anal plate precludes the reference, and we define it under the name of *locustarum*. Since the time when it was established by Fabricius, evidently on the characters of the European *T. holosericum*, the genus *Trombidium* has been greatly modified by different authors. The species have been variously arranged according to relative length of legs, position of eyes, divisions of the body, etc. As restricted at present, the genus is thus characterized. Abdomen swollen, especially in front where it is broadest; cephalo-thorax small and narrow, with two eyes, superior and barely raised;

[1] Journ. Ac. Nat. Sc. Phil. 11, 1821, p. 70.

legs 7-jointed, palpate, with two minute terminal hooks, the front pair longest: the two front pair widely separated from the two hind pair; mandibles unguiculate; palpi large, free, the penultimate joint strongly ungulate, and the terminal joint forming a movable thumb upon it. Larva 6-legged, parasitic; defined under the generic names *Astoma*, *Leptus*, *Lepostomus* and *Ocypete*. Many species have been described in Europe, but the one in question differs from all of them as given by Gervais.[1]

Trombidium locustarum Riley.—Egg, 0.12 mm. in diameter, spherical, full of granulations, pale orange-red in color, becoming more pointed at one end before hatching (Fig. 1*d*), the shell splitting across and the severed sides rolling toward each other when vacated (Fig. 1*e*).

Larva.—When newly hatched, pale orange-red, 0.14 mm. long, ovoid, the body with but three transverse sutures, one anteriorly, one between first and second, and another between second and third pair of legs; dorsum with several transverse rows of about six piliferous points; head somewhat narrowed, showing four minute swellings, each giving rise to a rather long hair; mouth-parts small and indistinct, with a dusky, granular spot at their base; legs 6-jointed, inclusive of fixed coxal piece, the third joint longest, hind pair somewhat longer than the others; all tipped with two well developed claws, those on front pair the longest; what appears to be a rudimentary sub-cutaneous fourth pair; no anal setæ.

Full grown larva.—1.6 mm. long, with the whole body greatly distended and elongated, the elongation being principally from the posterior dorsal portion so as to bring to view four hairs at the end; body showing two principal transverse constrictions, one about the middle, the other above it, while the whole surface is finely andtransversely striate.

Pupa.—17 mm. long, one-half as broad. Either pale yellow or orange-red, polished, swollen and rounded anteriorly, more tapering posteriorly, the dorsum well arched; two transverse impressions, at first noticeable but subsequently obliterated; palpi and legs formed under the larval skin, their ends finally projecting from it and more or less free; traces of the shriveled larval legs widely separated.

Adult.—When first from pupa the color is orange-red, with a distinct transverse constriction about the middle, and a deep transverse impression in the broad fore part. The species is characterized by the palpal claw consisting of one large hook, with a second smaller one originating from its middle, and three stout spines from near its base, and by the thumb being of uniform diameter, armed with rather long hairs terminally, and reaching

[1] Suites à Buffon. Aptères, 1844.

to or very little beyond its tip; also by a sunken polished plate at the end of the body dorsally; the plate but sparsely covered with hairs, elongate, square in front and broadening behind. The legs have the terminal hooks very short and blunt, the front pair is longest, the second shortest. Hairs of body barbed, slightly curved and attenuated. The scissor-like mandibles are faintly toothed within. With age the color intensifies to scarlet, but the legs, palpi and ventral surface are always more pale and silvery than the superior part of the body. The male is smaller than the female, has more intense color, relatively somewhat longer legs, wih the body more pointed behind and more deeply constricted; the anal plate more narrow; ventrally his body is more distinctly constricted toward tip, and more deeply impressed longitudinally; also with the genital impression more distinct. His body becomes more creased and impressed with age, while that of the female becomes broader and more smooth and swollen. Average length of female when full grown about 3 mm.; male about 2 mm.

Widespread. We have it from Manitoba, Texas, various eastern States and from California.

In each of the two egg-masses we have examined, the number ranged between 300 and 400, the mass being irregularly globose, and the eggs but loosely adhering to each other. We have not been able to ascertain the exact length of time required for the full development of the larva after attachment, but it is brief and seldom exceeds a fortnight, while the final transformation after detachment occupies but three or four days. Though the motion of the swollen and detached larva is slow, the legs move about with considerable rapidity, yet in the gradual change to pupa they shrink and are partially drawn in. Since De Geer's time it has been known that some of the octopod mites are hexapods in their early life, and there can be no doubt but that all the *Trombidiidæ* have hexapod larvæ. In addition to the locust mite above described, we have found another larval form attacking the mature *C. spretus*. It is at once distinguished from the larva of *locustarum* by the more prominent head, by the longer, more slender legs which are 7-jointed, the joints increasing in length to the penultimate which is longest, and by the hairs, whether on the body, legs or palpi, being long, tapering and barbed. It is possibly the larva of a large species which we have called *Trombidium giganteum*, distinguished by the following characters:

Trombidium giganteum Riley.—Adult 8 mm. to 9 mm. long; pyriform, somewhat flattened; no pronounced constrictions, but

various dorsal irregularities, usually about five pairs of circular depressions connected by transverse ones on anterior two-thirds, and a triangular series posteriorly. Barbed hairs, long and tapering, but very dense and even. Color deep scarlet, the legs concolorous; eyes dark. Characterized by the penultimate palpal joint forming a single claw with a prominent notch, while the terminal thumb is large, extending one-third its length beyond the claw, clavate and with the inner side of its broad end flattened; the claw as well as the thumb having sparse hairs; terminal joint of legs squarely docked, with the claws reaching but little beyond the side.

Fig. 3. — *Trombidium giganteum*; *a*, pedal claws; *b*, labial claw and thumb.

Living in the ground. Nine specimens examined.

We have also reared to the perfect state the well-known Astoma parasite that attacks the common house-fly (*Musca domestica*) in this country.

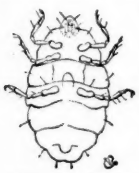

Fig. 4.—Larva of *Trombidium muscarum.*

The larva (Fig. 4) has the same mode of transformation as *T. locustarum*, but is much more active after detachment, while the gradual shrinking and withdrawal of the larval legs during the transformation to pupa is much more easily observed. The species is distinguished from *T. locustarum* by the following characters:

Trombidium muscarum Riley.—*Larva* distinguished from that of *T. locustarum* by the greater relative length of legs, and by the hairs on the body being much longer and more conspicuous; also by the more distinct transverse sutures, of which there are four. Transverse striations noticeable soon after attachment. Full grown larva also more active.

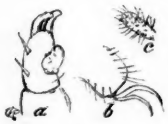

Fig. 5.—*Trombidium muscarum*; *a*, labial claws and thumb; *b*, pedal claws; *c*, barbed tuberculous hair.

Pupa.—More rounded behind.

Adult.—Average length 1.2 mm.; color bright and pale scarlet; legs very pale and with the terminal joint fusiform and the claws much longer than in *T. locustarum*, and more nearly as found in the larva; body rounded, very little narrower behind, with no impressions or other marks. Barbed hairs of body sparse, short, blunt and tuberculous, giving a beautifully sprangled appearance under the microscope. Genital depression circular; penultimate palpal joint ending in two small, equal, blunt claws, the thumb being very small, tuberculous, and not reaching its tip. No marked sexual differences.

Many specimens examined.

The mode of growth of these mites may be more clearly illus-

trated by a brief reference to a common red water mite (*Hydrachna belostomæ* Riley) which we have studied. The mites of the typical genus *Hydrachna* are, in reality, the aquatic representatives of *Trombidium*, and have a precisely similar mode of development. We have not had the eggs, but in Europe they are known to be laid in spring, in holes in soft-stemmed aquatic plants.

The young larva (Fig. 6*b*) like that of *Trombidium*, is pale red, hexapodous, and with the legs 6-jointed, including the coxal joint. It has the mouth-parts retracted, and is characterized by two dark eye-spots anteriorly, and by the swollen second joint of

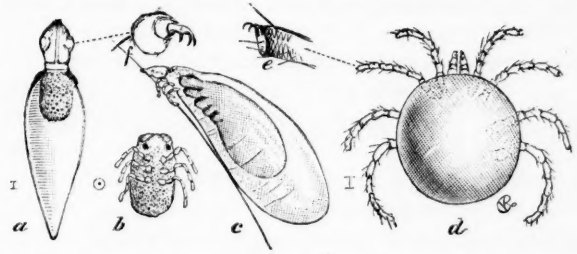

Fig. 6.—*Hydrachna belostomæ*; *b*, newly hatched larva; *a*, larva soon after becoming fixed; *c*, mature larva with pupa forming within; *d*, adult; *e*, its pedal claws; *f*, palpal claws of larva.

the palpi showing at each anterior corner. Moving about in the water these young larvæ fasten, often in very large numbers, to different aquatic insects. Water bugs of the family Belostomidæ are particularly subject to attack, and especially *Zaitha fluminea* (Say[1]), upon a single specimen of which we have sometimes counted over 500. They are able to fasten to the bug by means of several sharp hooks at the end of the palpi. Once fixed, the head and mouth parts stretch until they become separated by a neck from the main body, the transparent skin of which rapidly swells and elongates so as to form a bag with the more solid, dark-red parts visible anteriorly. (Fig. 6*a*.) The maxillæ penetrate and extend beneath the chitinous covering of the host, until they form a long pointed thread. The legs curl up, become useless, and are more or less withdrawn, and the larva gradually passes to the pupa state within this bag, which becomes more and more swollen and rounded posteriorly, and finally bursts to release the adult mite. This bag-like larva was looked upon as

[1] *Perthostoma aurantiaca*, Leidy.

an egg by many old authors, and was made the type of the genus *Achlysia* by Audouin.

The adult swims actively about in the water, but before attaining maturity fixes to some plant and undergoes another molt without material change of form.

Hydrachna belostomæ Riley.—*Larva.* Hexapodous. Elliptic-ovoid. Pale red, with two dusky eye-spots. Legs 6-jointed including coxæ; terminal joint longest; claws very small. Surface closely and evenly studded with minute points. Palpi drawn beneath the head with the second joint greatly swollen, and showing like an eye at each anterior side of the body; the three terminal joints indistinctly separated and each armed with a sharp hook. Becoming elongate and more or less pyriform, with a distinct neck when fixed. *Pupa* formed within the bag-like body of larva. *Adult*—Average length when first from pupa 1.5 mm.; globular; color dark blood brown; body smooth; legs with but few hairs, terminal joint truncate and with two very minute claws; palpal claws very small and the thumb no longer.

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THE HOME OF THE HARPY-EAGLE.

BY FELIX L. OSWALD, M.D.

NOT far from the old military road which unites the Mexican seaport of Tehuantepec with the cities of the table-land, there stands an ancient Spanish fort, *El Fortin de Tarija*, which is now used as a storehouse by the proprietors of a neighboring copper-mine, while one of the larger outbuildings has been converted into a tavern, where the stage coach stops for dinner. *Posada de dos mares*, Hotel of the two seas, seems rather a strange name for a posada situated in the heart of the Sierras, and at an elevation of at least twelve thousand feet above the level of any sea, but if the traveler deigns to alight and share the *table d'hôte* of the humble posadero he may convince himself that the name is not so very inappropriate after all.

"Forty minutes time before the coach starts Señor," my host will observe after dinner, "and if you never passed here before, perhaps you would like me to accompany you to the Fort and show you the *alta vista*, the grand view, from the parapet."

"Grand view? is there anything exceptionally grand about it?"

"Yes, sir, it is the grandest view in America, for you can see

los dos mares, the two oceans, at the same time! I only charge you one real (twelve cents) extra."

He who has never seen two oceans at the same time will very likely invest a real. The view is grand indeed. You stand on the back-bone of the American continent, which measures less than two hundred English miles from shore to shore here, and see the Gulf of Mexico so plainly that you might distinguish the smoke-trail of the New Orleans packet, or the glittering towers of St. Juan de Ulloa, while the Pacific, though thirty or forty miles nearer, glistens faintly through a gap of the Chiapas coast-hills, and but for the sharp-drawn line of its horizon might be mistaken for a mountain lake. Yet it is not the water that constitutes the grandeur of the *alta vista*, it is the land, the main-land of the western world, of which you see a larger and fairer portion from the parapet of Fort Tarija, than from perhaps any other point between Mount St. Elias and the Peak of Aconcagua. Far from the north, from the distant border state of Sonora, descends a mountain chain which is easily recognized as the Sierra Madre, the main and central chain of the American continent, the southern prolongation of the Rocky mountains of New Mexico and Colorado. A second Sierra, a continuation of the California Contra-costa range, lifts itself in the north-western sky, and may from here be traced through a succession of fainter but snowier summits that seem to rise with the distance, till they culminate in a stupendous peak, the extinct volcano of Culiacan, which looms like a jagged white cloud over the edge of the horizon. About ten leagues, or thirty English miles, from the Fort the two Sierras unite, and between their icy ridges, their wild crags and their forests of evergreen pines enclose a mountain-land which is perhaps, after all, the true paradise of the western hemisphere.

From the regions of eternal snow to the lakes and fruit-groves in the valleys that communicate with the primeval forests of the *tierra caliente*, this vast triangular terrace-land, the great mountain valley of Oaxaca, exhibits every degree of elevation, the climatic extremes with all their intermediate grades and almost every variety of the American fauna and flora. On a surface of six thousand English square miles the eastern half of the state of Oaxaca unites a greater abundance and variety of animal and vegetable life than any other American country of equal extent,

and the exuberant fertility of its lower valleys is only equaled by the coast regions of the Sunda islands. Life seems intensified here. The mightiest trees and the strongest animals, as well as the sweetest fruits and most brilliant birds, are found together in this garden of the Hesperides, which (from all but a political standpoint) would appear, even to a patriotic Yankee, as superior to the finest portions of the United States as the hill counties of Southern Tennessee are superior in beauty and fertility to the most favored districts of Labrador.

Between the two main forks of the Rio Verde, and within a circuit of fifty English miles, the naturalist may find from sixty to seventy-five different species of palm trees, wild growing oranges, figs and almonds, four varieties of the *Musa paradisiaca;* the Adansonia and the dragon-tree, with their gigantic trunks, the most gorgeous butterflies, the largest reptiles and Carnivora of the New World, including the *Boa imperator* and the jaguar, and the strongest if not the largest of all American birds, for the forests of Southern Mexico are the favorite home of the Harpy-Eagle, the king bird of our western continent.

Even animals of a wide latitudinal distribution show an elective affinity for some special country which may have been their "centre of creation," and has always remained their favorite abode, where they will survive after their species has become extinct in other lands, and which may, therefore, be called their home *par excellence.* The tiger is thus at home in the Sunderbunds of the Ganges Delta, the bustard (*Otis tarda*) on the plains of Southern Russia, the flying squirrel in the Southern Alleghanies, and the prairie dog in North-western Texas, near the head waters of the Red River. The harpy-eagle (*Harpyia destructor*) has been shot in the mountains of South-western Bolivia, in the Mornes du Diable of St. Domingo and in the valleys of Southern California; but a hunter may range those regions for years without getting a chance to add to his trophies the feather coronet of the *aguila real,* the king eagle, as the Spaniards call him, while every farmer's boy of an Oaxaca mountain village knows an eyrie or two in the neighboring crags, which he is ready to rob of its eaglets or large white eggs for a couple of reals. From the projecting rocks of the lower Sierra, on any bright morning of the year, one may see the hovering form of the destructor suspended in the clear sky or wheeling in ascending circles over the misty ocean of foliage.

and from March to the end of June the tree-tops of the *tierra caliente* resound with the screams of the ever-hungry eaglets.

In the spring of 1875, I sent a pair of callow harpies to Messrs. McAllister & Co., of Vera Cruz, who took them to Philadelphia the next year, where one of them is now, while the other found its way to New York. They were the first living birds of their species that ever reached our Eastern States, I believe, with the exception of a wounded old hen-harpy of extraordinary size, that was shot and captured near Tampico by Colonel Godolitz, of the Austro-Mexican army, who took her to St. Louis, Mo., where she died soon after her arrival, either from her wounds or from the effects of the climate. A so-called harpy, which is kept in the Zoölogical Garden of Munich, I found to be a Brazilian eagle (*Polyborus tharus*), which, properly speaking, is no eagle at all, but like the *Læmmergeyer* of Switzerland, a compromise between the *Falconidæ* and vultures. None of the repeated attempts to carry the genuine harpy-eagle to Northern Europe has succeeded, as far as I know; owing more probably to its sensitiveness to cold than to its impatience of captivity, for the *aguila real* is a common pet in the farmhouses of Southern and South-western Mexico.

On the hacienda de Tuxpan, the hereditary estate of the Santa Anna family, I saw among other curiosities a tame eagle, which had been kept in and near the house for upwards of twelve years, and had been so much indulged in all its whims that it had come to consider itself as a privileged member of the household. It was a fine specimen of the genuine crested king-eagle, and gave me the first opportunity to study the physical and moral peculiarities of the species.

The *Harpyia destructor* is well equipped for its trade. A square, strong head, armed with a most viciously curved, powerful bill, that can crush a man's finger-bones without any special effort and dislocate the neck of a squirrel-monkey by a single wrench; broad compact wings, moved by shoulder-muscles of enormous strength, and a pair of stout legs, feathered to below the tarsi, that terminate in claws of such extraordinary power and sharpness that they leave marks on the skin of a quadruped and even on the tough leather of a Mexican saddle like the bite of a wild-cat. The harpy is often killed for the sake of its feathers, I mean for the feather-bed value of its plumage, by the Mexican Indians,

and if plucked, yields about four pounds of soft, grayish-white down, beside the stiff wing and tail feathers and the bristling tuft which crowns its head. This plumage is so elastic, so compact, and so firmly imbricated that buckshot, striking the wings or the breast of the bird at a certain angle, glance off or fail to penetrate to vital parts; and monkeys or foxes which in their death struggle snap at what they mistake for the throat of their captor, shut their fangs upon a mass of elastic down, which baffles their efforts till the grip of the destructor closes upon their own throats. The harpy can overtake the swiftest birds of the tropical woods, and, in spite of its size, steers its way through the labyrinth of forest trees and hanging vines with amazing skill, and rarely fails to rise with a pheasant, a woodcock or a small mammal in its claws after plunging like a meteor from the clouds into the leafy maze of the *tierra caliente*.

The full-grown eagle walks in stiff grandezza, with its head erect and its crop thrown out, after the manner of strutting turkey-cocks, except, if charging an enemy, when he lowers his head like a vicious buck, half opens his wings and rushes to the encounter with a succession of flopping jumps. The old hen-harpy measures about three feet from its crest to the base of the tail, and from six to seven feet with outstretched wings. The male is somewhat smaller, but the strength of the bird in proportion to its size is altogether abnormal. It has been said that a bulldog is readier to fight an antagonist of superior bulk than any other animal; and speaking merely of the courage to attack a foe without regard to his size, this is probably true, for, at the bidding of its master, an English bull-terrier will charge a beagle or a bear with equal promptitude, but if we speak of the ability to vanquish as well as to assail larger animals the first prize belongs indisputably to the *Harpyia destructor*.

The *lobo volante*, or winged wolf, as Quesada translates the old Aztec name of the harpy, attacks and kills heavy old turkey-cocks, young fawns, sloths, full-grown foxes and badgers, middle sized pigs and even the black Sapayou monkey (*Ateles paniscus*), whose size and weight exceed its own more than three times. The old eagle on the hacienda de Tuxpan engaged, not in a friendly bout, but in mortal combat, the big shepherd's dog of a neighboring farmer who visited the hacienda now and then, and was only vanquished by a second dog that came to the aid of

his brother. The colly, who looked as if he had encountered a pack of wolves, managed to limp off, but on his way home dropped by the roadside, *exsanguis*, and a *post-mortem* examination showed that he had bled to death from a deep gash in his throat, that one of his eyes had been torn out, and that in the fight of ten minutes the bones of his skull and breast had been laid open in as many different places.

At the return of President Juarez to the Mexican capital in 1867, the festive bull-fights were supplemented by various side-shows, and in the vestibule of the Grand Arena a pugnacious old cock-harpy was pitted against a Mexican lynx (*Felis onca*), which had been crippled by a shot through its haunches, but was otherwise in good fighting trim and very much inclined to take satisfaction out of somebody. The bird was torn to pieces; but the mammal did not survive him many minutes, having been literally flayed from its shoulders to the tip of its nose.

Professor Buckley, State Geologist of Texas, told me that he shot a harpy in the jungle-delta of the Rio Grande, but failed to capture it, though both its wings were broken and the blood issuing from its beak gave proof of severe internal injuries. In this crippled condition the bird kept the dogs at bay by turning on its back and presenting its claws after the manner of a wounded cat, shuffling off at the same time by an alternate movement of its neck and tail, till it reached the edge of the jungle, into which it disappeared before the hunter had reloaded his shot-gun.

The organ of vitality, which, according to Lavater's definition, inspires a tenacious adherence to life, must occupy a large portion of the harpy's brain, and enable it to survive injuries which would terminate the nine lives of the most vigorous tom-cat. No Mexican hunter of experience will waste ammunition by a long-range shot at a crested eagle, for unless the bullet shatters his head or breaks one of his wings, the bird flies off as if nothing had happened, though a cloud of feathers flying from his breast or abdomen may attest that the shot has not missed altogether. A Mexican miner who left the blast furnaces of St. Miguel, near Orizaba, before day-break one Sunday morning and descended the mountains by a short-cut, surprised a pair of harpies on their eyrie, and with a common cudgel knocked down one of them, which, either to scare the intruder or because it was scared out of its own wits, flew directly at his head. The bird flopped

among the boulders, but before it could take wing again, the miner put an end to its struggles with a few well-aimed whacks, and shouldering his game, resumed his road towards the valley settlements. Half-way down the hill he reached a steep cliff and shifted his burden to his left shoulder, to use his right arm to better advantage. But at the most critical moment of the dangerous descent he suddenly felt the claws of the eagle at his neck, and, in order to save himself, had to drop his stick, which fell down the cliffs and into the bed of a mountain torrent. Holding on to the bird with one hand, he managed to reach the foot of the precipice, where he seized the struggling captive by the legs, and swinging it up, dashed its head against a rock, till its convulsions had ceased entirely. His arrival in the village with the story of his adventure, created quite a sensation, but when the bird was deposited on the ground to be examined at leisure, it revived for the third time, struck its claws through the hand of its captor, struggled to its feet and would have escaped after all, if the enraged miner had not flung himself upon it, seized a rock and hammered its head to a jelly.

As soon as the lengthening days of the year approach the vernal equinox, the hen-harpy begins to collect dry sticks and moss, or perhaps only lichens with a few claws' full of the feathery bast of the Arauca palm, if her last year's eyrie has been left undisturbed. Her favorite roosting places, the highest forest trees, especially the *Adansonia* and the *Pinus balsamifera*, and the more inaccessible rocks of the foothills, are commonly also chosen for a breeding place, and it is not easy to distinguish her compact-built eyrie on the highest branches of a wild fig-tree from the dark-colored clusters of the Mexican mistletoe (*Viscum rubrum*), which frequents the same tree-tops. The eggs are white, with yellowish brown dots and washes, and about as long, though not quite as heavy, as a hen's egg. Of these eggs the harpy lays four or five, but never hatches more than two, or, if the Indians can be believed, feeds the first two eaglets that make their appearance with the contents of the remaining eggs. The process of incubation is generally finished by the middle of March, if not sooner; and from that time to the end of June the rapacity of the old birds is the terror of the tropical fauna, for their hunting expeditions which later in the year are restricted to the early morning hours, now occupy them for the larger part of the day.

From the garden-terrace of *El Pinal*, a little villa on the ridge of the Organos mountains, I frequently watched a pair of harpies that had their nest in the crags below. The hen-bird, which could be recognized by her larger size and the greater energy of her movements, generally made her appearance a few minutes before sunrise, mounted to the upper sky, as if to study the meteorological probabilities for the coming day, and then proceeded to business. After wheeling at an elevation of some hundred feet over the tree tops, in a circle or rather in a contracting spiral for a couple of minutes, she commonly would stop short, hover with quivering wings for a second or two, and then dive into the leafy ocean below, with a headlong rapidity that could hardly be followed by the eye, but evidently with a practical purpose, for her descents were generally succeeded by the ascent of a cloud of birds or the shrill piping of the squirrel-monkeys (*Callithrix sciureus*) and the exultant scream of the wild huntress from the depths of the forest. Then followed a pause, devoted to domestic duties, during which the thanksgiving duet of the eaglets ascended from the cliffs, and very soon after one or both parents reappeared in the upper air to resume the work of destruction.

The callow harpies, with their pendant crops, their misshapen big heads and their preposterous claws, resemble embryo demons or infantine chimeras rather than any creatures of nature, but they grow very rapidly and their appetite during the first six months of their existence is almost insatiable. The pair which I afterwards sent to Vera Cruz kept an Indian boy busy from morning to night, cleaning their cage and refilling their trough with a ragout of fish, pork and hominy. The exigencies of two or three harpy-nests to the square league, which I take to be the average ratio of their distribution would exhaust the food supply of any other region but that of a tropical jungle, and even there the eaglets would have to be stinted in the rainy season, if it was not for the harpy-eagles' impatience of any competition. His tyranny over the kingdom of the air tolerates no rival; the falcons and the *Aquila chrysaëtos* have to confine themselves to the icy rocks of the upper Sierra, the *Strix bubo* and other owls are bound under heavy penalties to keep the peace during daylight and the sea-eagle is pursued for miles with implacable fury whenever he ventures to trespass upon the rivers of the *tierra caliente*.

Of all the *aquilinae*, the harpy is the only one that tolerates no interference with his business by jackdaws, jaybirds and other police agents of the woods. In his excursions to the upper mountain forests he is often attacked by swarms of the iris-crow, the sworn enemy of the falcon kind and all other *Raptores;* but, unlike the others, the harpy invariably turns upon his pursuers, and by capturing and tearing one or two, greatly moderates the zeal of the others.

In the choice of his game he shows a great latitude of taste and seems to devour with equal relish a fat iguana-lizard, a young woodcock or a tough old monkey. During the wet season, when pheasants won't break cover and squirrels stay at home, the *Harpyia destructor* may often be seen perched on some overhanging bough at the edge of a lagoon or large river, in wait for waterfowl. If you can watch him unobserved, you may see him get ready if the squawk of an approaching string of wood-ducks resounds from the depths of the everglades. He half opens his wings, bends his head up and down so as to put his perch into a rocking motion, and then leans forward like a catamount preparing for a spring. As soon as the unsuspecting mallards have passed his tree, he flings himself ahead, with wings laid back and claws ready for action and shoots like an arrow between the water surface and his game, thus getting them completely at his mercy. After rushing forward in blind obstreperous flight for a few hundred yards, the frightened ducks resign themselves to their instinct, which guides them waterwards; but before they touch the saving element the harpy is in their midst, with time enough and to spare, to make a judicious selection. He can catch fish, too; does not disdain the black watersnakes that glide through the shallow ponds of the coast-jungles, and even anticipates the trick of the tortoise hunters that uncover the oily eggs which the carey turtle has covered with the sand of the shallow river banks. But during the larger part of the year he seeks his quarry on the trees of his native woods, and causes more distress and dire commotion among the tribes of the gallinaceous tree birds, raccoons, frugivorous rodents and monkeys than all their other enemies taken together.

The upper branches of the tall mango trees which are visited by swarms of Sapajou monkeys during the fruit season, become the scene of a horrible hubbub if one of the wary quadrumana espies the hovering form of the arch-fiend, getting ready for the

first act of an oft-repeated tragedy, and gives the alarm signal by a coughing scream, followed by the yells and confused chattering of the entire party. They huddle together like a flock of frightened sheep, the mothers especially endeavoring to push their babies into the centre of the crowd; but in the midst of the preparations the screech of some outpost gives the signal for a general *sauve-qui-peut*—the murderer is upon them, has grabbed some unlucky youngster between neck and skull and flies away, with the switching tail of the captive depending from between his claws, while the pitiful piping of the bereaved relatives mingles with the grunts of execration of the old patriarchs. The whole assembly then repairs to the upper branches for a chattering indignation meeting.

A struggling monkey generally throws its hands up, and by thus losing its hold upon the branches, gives the enemy a fatal advantage; but the large bluish-gray squirrel of the Mexican woods (*Sciurus gigas*), if pounced upon so unawares that it has no time to regain its hole, either throws itself headlong to the ground or jumps toward a stout bough, takes hold with its four legs and four teeth at once and never loosens its grip while a spark of vitality remains in its claws or jaws. The harpy then either devours his prey *in situ*, by tearing piece after piece from the quick body, or relaxes its hold and takes wing for a moment, which often betrays the squirrel into the imprudence of letting go and taking a flying jump into space, in the hope of reaching the ground, where it would easily escape in the thick underbrush. Anticipating this, the eagle has perched upon a lower branch, with his wings half open, and intercepts the *salto mortale* by catching the jumper in mid-air.

During the sultry hours of the early afternoon the harpy-eagle participates in the general siesta, and may often be seen perched upon a lower branch of the *caucho* or some other dense shade-tree, alone or in company of his mate and the eaglets of the last brood. Swaying from side to side and crooning to himself in a sort of snoring or murmuring purr, he sits thus for hours, enjoying the sweets of digestion, till the lengthening shades and the reawakening voices of the forest summon him to supper or to one of those aerial excursions in which a pair of breeding harpies joins toward sunset as often as in the early morning hours.

The Incas and Aztec noblemen trained harpy-eagles like

falcons, and preferred them to tame panthers, which were used by pot-hunters to capture deer and young peccaries. Devega, the biographer of Hernan Cortez, says that the satrap of a Mexican province presented the Great Captain with a hunting-eagle, called *El Hidalgo del aire*, the prince of the air, whose value was estimated at the price of ten slaves; and adds, that the only bodily injury which Cortez ever received during his adventures in Mexico, was inflicted by this eagle. The cruel Spaniard used to prick the bird with his dagger, because he would not obey the hood, *i. e.*, did not wait for the signal of attack, as the Castilian gerfalcons were taught to do, and once, when the eagle repeated this error and took wing without proper authority, the angry hunter sent a pistol ball after him, "to teach him manners." The shot cured him of his bad habits forever, for it broke his head, and the prince of the air tumbled down with his talons quivering in the death shudder. Cortez dashed his pistol to the ground and knelt down in the hope of saving the victim of his passion; but Hidalgo was booked for the happy hunting grounds. Three or four times he tried to rise to his feet, and then lay still, his strength ebbing away with his life blood. But before he resigned himself to death, he raised his head once more, grabbed the best finger of the right hand of his cruel master, and bit it through—crushed it completely, "so as not to leave the world unavenged," as Devega says.

The Princes of Tlascala wore the image of the crested eagle on their breasts and on their shields, as a symbol of royalty, and could not easily have chosen a fitter emblem. The *aquila real* does not wear his crown in vain, he is a true monarch and embodies all the ideal characteristics of a wild warrior. Proud, strong, swift, wary and bold to a surprising if not to a sublime degree, he meets no superior but the omnipotent biped that has not inappropriately been called the god of the animal world, and among the tribes of his own element he recognizes neither a chief nor a rival. The tropical forests between the Gulf of Mexico and the head-waters of the La Plata are his domain, and he has chosen his home well. There will be forests and game and wild liberty in those regions after the last wilderness between Texas and Labrador has disappeared and all Northern America is either a treeless waste, like Turkistan, or a hive of industry like Germany and Great Britain. The continuous woods that once cov-

ered Europe from Portugal to the foothills of Caucasus have disappeared, the mountains of Persia have become naked rocks and the promised land is a desert; but the Sunda Islands, Southern India, Siam, Ethiopia and the birthland of the Nile are still as sylvan and as prolific of life as in the springtime of creation. Not only the ocean but the vegetation of the tropics can defy "the vile strength, which man for earth's destruction wields," and Macauley's New Zealander who might visit the desert relics of American cities after musing over the ruins of London, would still find the primeval forests that covered the southern part of our continent when Humboldt and Bonpland explored the valley of the Amazon.

"These forests will be felled," says De Tocqueville, speaking of the Calaveras cedar groves, "they will disappear as the cedars of Lebanon and the mountain-firs of Scotland have disappeared; these and all other forests of the cold and temperate zones. The trees of the tropical woodlands are the only true evergreens on earth."

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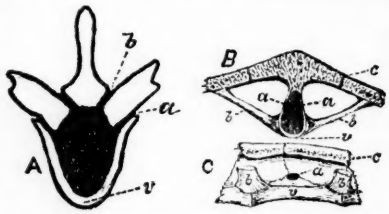
ON LIKE MECHANICAL (STRUCTURAL) CONDITIONS AS PRODUCING LIKE MORPHOLOGICAL EFFECTS.

BY JOHN A. RYDER.

APROPOS of the interest recently manifested in the matter of "the relation of animal motion to animal evolution,"[1] I have thought it pertinent to offer the following remarks. The possible morphological effects of like mechanical or structural conditions are illustrated in the vertebral axes of turtles and extinct armadilloes (*Hoplophoridæ*), where the rigid exoskeleton (carapace) has caused the originally segmented axial skeleton to exhibit a strong tendency to revert to the primitive homogeneous (notochordal) condition, without at the same time losing its osseous character. The exoskeleton in both these groups has assumed in part the function of the chitinous exoskeleton of articulates. The vertebral axis relieved in both instances from the transverse flexures incident to locomotion and respiration, has coössified into a solid bony bar, or rather a hollow tube, with loss of the cylindroid form of centrum. The vertebral centra are in both represented

[1] See E. D. Cope in this Journal for January, 1878.

by the inferior wall of the "dorsal tube," *v* in the cut.[1] The extremital portions of the axes in both, manifest more or less distinctly the action of flexion in preserving the axial elements separate, since, in the necks and tails of both, there still remains more or less of mobility. In both, the union of the vertebræ has resulted in a similar disposition of the lateral foramina for the exit of the spinal nerves, that is, these open midway of the length of the vertebræ, piercing the lateral wall of the dorsal tube, and not passing out laterally between the bony arches of the neural canal, as happens in other vertebrates (see A, *a*, B, *a* and C, *a*, of cut). The reduction of the centra in the higher tortoises is, as should be expected, much more manifest than in the lower forms, and the union with the carapace, though not extensive, is manifested in the armadilloes by sutural union in the lumbar region. Similar structural alterations, which are believed to be similarly due to alterations in the mechanical relationship of the skeletal elements, are to be observed in the sacra of birds and mammals where the ilia have been greatly elongated so as to prevent lateral flexures of this portion of the column. The ribs in turtles have been involved in the dermal ossifications, and are therefore, as should be expected (B, *b* and C, *b*), united to the vertebral axis by suture; this is not the case in the *Hoplophoridæ*, where, owing to the preservation of the more highly specialized mammalian respiratory apparatus, the vertebro-costal articulations are still preserved, with loss in large measure of movement in an outward direction of their sternal ends. The costal movement was probably from behind forwards, with return, since the only articulation of the thoracic axial skeleton which is preserved, is that between the twelfth dorsal vertebra and first lumbar. *A priori* we should expect the phylogenetic history of the vertebral axes of the order



A, transverse section through the "dorsal tube" of *Panocthus tuberculatus*, reduced, after Burmeister. B, the same through the dorsal region of a salt-water terrapin (*Malacoclemmys*), original. C, side view of dorsal vertebra of *Emys europæa*, after Bojanus.

[1] A similar degeneration and anchylosis of the centra is observed in the cervical vertebra of *Dipodomys*, as I have recently ascertained from a specimen sent me by Dr. Coues.

of Chelonians to agree with ontogenetic history or embryology of the individuals of the highest family. This, so far as I have been able to make investigations, proves, in a measure, to be the case, for it is observed that that portion of the vertebral axis included within the carapace in a young *Cistudo* has the vertebral centra more nearly of the character of the same parts of the lowest turtles, which approximate in the development of their centra to the normal or usual types of vertebrates with segmented axes. The degeneration of the vertebral axis in *Cistudo* into a mere tube, with exceedingly thin walls for the lodgment of the spinal cord, may probably be regarded as an instance of Cænogenesis.

These observed coincidences, it is believed, are neither accidental nor designed by an active cause external to these organisms or their cosmic environment. I would rather believe that the structures, so far as they have been evolved in parallel or similar ways, are the results of like forces conditioning growth and nutrition in definite modes and determinate directions. The manner of incidence of the modifying forces being in all cases determined by the voluntary actions of the organisms; the actions in turn are determined by the degree of intelligence of the animal manifesting them.

The origin of dermal ossifications is to my mind rationally explained by supposing the bioplasm of each dermal cell as sensitive and irritable to rude or violent external impacts, which, oft repeated, act as stimuli of growth force, determining certain tracts of these cells as the nidus within which osseous particles eventually appear as nuclei of the future defensive dermal bony system. This happens in the true skin and not in the corneous epiderm, which is still retained in more or less rudimentary condition in both Chelonians and Armadilloes, though it is not to be forgotten that in the toothless old-world Edentata it is the epiderm which becomes the defensive covering. This thickening, though not depending upon peculiar movements of portions of the body, as in the origin of hoofs, horns, etc., of other forms, depends upon the motion of the whole body mass, during which the hurtful stimulating impacts with the environment take place; so that the *rationale* of the origin of dermal ossifications is finally resolved into terms of osteoblasts and animal motion. The likeness of the process of the evolution of a defensive osseous or corneous derm, as sketched above, to the process of reparation in wounds is very

great, indeed, in no essential are they different, except that the former usually goes forward in a bilaterally symmetrical way, while in the latter it most frequently does not.

The preceding facts and considerations embrace what may be regarded as the complementary principle demonstrating the mechanical theory of axial segmentation or origin of vertebræ, as proposed by Spencer, since it must be allowed, that if segmentation is due to flexures of the vertebral axis, conversely, union, coössification of segments, is due to their absence, because opposite conditioning causes must produce opposite effects in two things respectively so conditioned.

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ON THE TRANSPIRATION OF PLANTS.[1]

BY J. M. ANDERS, M.D., PH.D.

IN looking over the literature of the subject, one is surprised to find how little definite knowledge we possess in regard to the process of plant transpiration. When the importance of the subject is considered, there would seem to be no explanation for this apparent omission of research.

It has been pretty well established that transpiration is produced and modified by influences acting from without, and by the structural peculiarities of the plant. Most important among the former modifying agencies are sunlight, wind, dew point and temperature ; and among the latter circumstances is to be mentioned, more particularly, the nature of the epidermal tissue. The precise connection between these various conditions and the amount of water evaporated has not been investigated to any considerable extent; and the most important question, viz.: the amount of liquid ordinarily transpired by different plants has, also, hitherto been quite as sadly neglected.

A few bare statements are made in relation to the quantity of transpiration (Gray's Structural and Systematic Botany). A sunflower 3½ feet high, with a leaf surface of 5616 square inches, when exposed to the air, evaporated from 20 to 30 ounces in twelve hours, being seventeen times as fast as man exhales. A seedling apple tree, with leaf surface amounting to 112 square feet, evapo-

[1] The Geo. B. Wood prize essay, 1877, read before the Society of the Alumni of the Auxiliary Dept of Medicine, University of Pennsylvania.

rated at the rate of 9 ounces per diem, and a vine with twelve square feet of leaf surface, transpired at the rate of 5 to 6 ounces per day. The sunflower during a dry night lost 3 ounces, but nothing on a dewy night. The method adopted in these experiments is not referred to by him.

Balfour, in his work on botany (page 457), refers to the investigations of Woodward, giving some of the results of this observer. Woodward took plants, and, having immersed their roots in water, placed them in the light for more than a month. He noticed the quantity of water absorbed and the amount transpired (making allowance for extraneous evaporation), and showed that the greater quantity of the water absorbed was again given off by the leaves.

It is questionable whether results thus obtained are to be relied upon, inasmuch as these plants must have been placed under unnatural conditions and influences, by allowing their roots to rest in pure water; for it is a known fact that certain plants (Calla Æthiopica, for instance) can be made to distill the water in drops from their leaves, if too abundantly supplied to their roots.

Curiously enough, in every instance in which the methods adopted have been detailed, the objectionable circumstance of placing the plants in a very unnatural state while experimenting upon them has obtained. Reference is here made only to experiments on entire plants. The results of the observations of Garreau (Annales des Sciences Nat. 3d Ser. Bot. xiii. 355) on the transpiration from leaves should, doubtless, be accepted as reliable, if we consider the means employed. This observer estimated the amount of exhalation by collecting it by means of chloride of calcium, placing the leaf between two bell-jars, one applied to its upper and the other to its under surface. His conclusions were:

"1. The quantity of water exhaled by the upper and under surfaces of the leaves is usually as 1 to 2, 1 to 3, or even 1 to 5 or more. The quantity has no relation to the position of the surfaces, for the leaves when reversed gave the same results as when in their natural position. 2. There is a correspondence between the quantity of water exhaled and the number of stomata. 3. The transpiration of fluid takes place in greater quantity on the parts of the epidermis where there is least waxy or fatty matter as along the line of the ribs."

Among the reported results that my eye has been able to reach, the foregoing only are considered worthy of special notice. Possibly some have escaped notice.

The present experiments have been performed more especially with the view of ascertaining, as nearly as possible, the amount of water evaporated by plants in a healthy, natural state, and, also, to determine the connection between the meteorological conditions and variations and the nature of the cortical tissue, and transpiration. The importance of keeping the plants in a perfectly normal state while being experimented upon was called attention to by Prof. Rothrock when lecturing on the subject of evaporation from plants. To accomplish this it was suggested by him at the time that something impervious to moisture be adjusted to the receptacle in which the plant had previously been growing, fitting the same accurately to the base of the stem, the object of it all being to prevent any evaporation from the vessel or earth in which the plant was situated, so that all evaporation would be from the plant itself above the ground. The plant was now to be weighed at stated intervals and the loss of weight in any given time would represent the weight of the liquid transpired. It is evident that this, with properly balanced scales, would show exactly the quantity evaporated, save the slight increase in weight of the plant by the gases derived from the air which it fixes in the time of one experiment. This certainly must be regarded as extremely small when we reflect that plants return to the atmosphere the greater portion by volume of the gases absorbed by them. The circumstance of plants gaining slightly in the course of a day by the gases they fix from the air, it will be observed, is not calculated to favor an over-estimate of the quantity transpired.

The means employed to accomplish these ends were as follows:

A piece of good rubber cloth of sufficient size was taken and its narrower border tucked up neatly around the base of the stem of the plant and secured by means of an elastic cord. The rubber cloth was then allowed to drop down over the vessel in which the plant was situated, the portion of the cloth underneath the pot gathered up and brought to one side of its base, and after giving it a few twists in one direction so as to insure its close application to all parts of the pot, the twisted portion was well wrapped and tied off by means of a cord so as to keep it in this condition. This

done, the line of separation at the point where the edges of the cloth met, was remedied by allowing an overlapping of two inches or more and sealing by means of gum mucilage. It was now thought that evaporation from the vessel in which the plant was situated was next to impossible; but the question next arose, "How is the plant to be supplied with the necessary moisture?" This difficulty was overcome by taking a hollow cylinder of tin 3-4 inch in diameter, and about 3 inches in length, and having made a hole of sufficient size in the cloth covering the pot, a few inches from the stem of the plant, introducing one end of this tube into the opening, the rubber cloth was tucked up and tied on it the same as in the case of the stem of the plant, the external opening of the tube being guarded by means of a cork.

It would be useless, as well as illogical to assert that this arrangement would allow of no escape of moisture whatever, yet there is perfect safety in affirming that the quantity thus lost sinks into insignificance compared with the amount actually transpired by the plant itself. The loss by insecurity of this method could certainly not exceed a few grains per day.

The plants were watered in the morning before weighing them for the day's experiment, and just sufficient water was given them to keep them in a natural state, the condition of the leaves being in all cases taken as a guide. After watering the plants in the morning they were carefully weighed and then placed in the desired position and left undisturbed till evening, or any number of hours desirable, and then were again weighed (as a rule before any more water was given). The loss of weight, as before stated, was considered equivalent to the amount evaporated during the time of the experiments.

Usually the observations were made for a day and a night, but the plants were also weighed in the evening so as to establish the relation between night and day evaporation during the same twenty-four hours. As before intimated the relationship between the dew point, temperature, etc., and the rapidity of transpiration was noted in most of the observations made. This was arrived at by means of the ordinary wet bulb thermometer, taking the average temperature and dew point according to the well known rule, which it would be needless to detail here.

With this brief yet, it is hoped, sufficiently comprehensible description of methods pursued, we shall pass to the notice of results obtained by these researches.

Plant No. 1 employed, was a common Calla (*Calla Æthiopica*), an herbaceous plant 3 feet 1½ inches high. Its whole weight on taking it up, with roots cleaned, was 2 pounds 2 ounces; weight of evaporating portion, or all above ground, 1 pound 3 ounces, 240 grains in a green state; complete weight of outfit, including plant, vessel, and apparatus adjusted for experimentation, 21 pounds 4 ounces 20 grains. This latter weight is here stated in order to avoid an unnecessary record of figures in the table of results to follow, by giving the weight of the growing plant at each time it was taken. Suffice it to give the loss of weight, or its equivalent the amount of water evaporated during the periods of time indicated. The same plan will be pursued hereafter.

The following are the results with this plant:

Ex.	Duration of Experiment.	Loss of weight or amount evaporated.	Place.	Weather.
I	12 hours, day.	1420 gr.	Indoors.	Clear.
II	12 "	195 "	"	Cloudy, rain.
III	12 "	1440 "	"	Clear and warm.
IV	12 "	2040 "	In open air.	Partly cloudy.
V	12 "	2380 "	"	Clear,
VI	12 "	3320 "	"	Clear, windy.

The important part played by the sun's rays and atmospheric currents in transpiration is very well shown by these results. The plant while indoors received the sun's rays only about half the time during a clear day, which was the case in all indoor experiments made, and, although the room in which it was kept was well ventilated, the currents were in no way comparable to the circulation of the atmosphere outside. It was found, very curiously, that this plant evaporated nothing during a cloudy night in or out of doors, and only about 460 grains on an average during clear nights in open air.

Plant No. 2 was one of our common geraniums (*Pelargonium cucullata*); also herbaceous; 18 inches high; weight in a green state, with roots washed, 9 ounces 120 grains; of green or exhaling part 7 ounces; complete weight fitted for experimentation, 9 pounds 15 ounces 350 grains. The evaporating surface of the two first plants tried was not estimated on account of the shape of the leaves, and the extent of the branches in the case of the geranium and of the leaf stalks in the case of the calla (which it would have been necessary to include) rendering it too difficult for the observer. It might be well to state here that the plants

were taken up *after* the experiments made upon them, in order to ascertain their weight.

The geranium gave the following results:

Ex.	Duration of experiment.	Loss by evaporation.	Loss by day, 12 hours.	Place.	Weather.
I	Day and night.	1560 gr.	1080 gr.	Indoors.	Clear.
II	"	1930 "	1440 "	"	Clear, warm.
III	——	——	1286 "	"	Clear.
IV	Day and night.	3380 "	2880 "	In open air.	Clear.
V	"	3730 "	3220 "	"	Clear, very warm.
VI	"	3390 "	2900 "	"	Clear.

These results indicate that the amount exhaled at night is about the same in the open air as in the house, while the evaporation in day time is more than double in the former position what it is in the latter in the same length of time. It will be observed that this plant evaporated more than the weight of the portion with exhaling surface in the course of twenty-four hours. It should be remarked that this and the previous plant were in the flowering stage.

Plant No. 3, a fuchsia (*F. macrostemma*), was a shrubby plant in the flowering stage; leaf surface estimated at 450 square inches; height of plant 27 inches; weight of the portion having evaporating surface 2 ounces; of whole plant, with roots washed and in a green state, 4 ounces; complete weight of outfit ready for experiment, 9 pounds 15 ounces 360 grains.

Coincident with the remainder of the experiments, daily observations were also made on the average temperature and dew point. It should be stated that these latter observations were taken in the same medium in which the plant was situated.

This plant gave the following interesting results:

	Duration of Experiment.	Loss of weight by evapora'n	Loss by day, 12 hours.	Avera'e temperature.	Average dew point.	Place.	Weather.
I	Day and night	1810 gr.	1260 gr.	77.°	61.4°	Indoors.	Clear.
II	"	1800 "	1240 "	72.	51.2	"	Clear.
III	"	1450 "	980 "	68.	49.9	"	Partly cloudy.
IV	"	2270 "	1910 "	63.5	49.5	In open air	Cloudy, some rain.
V	"	2415 "	1930 "	65.9	50.5	"	Clear, partly cloudy.
VI	"	2510 "	2020 "	65.	49.9	"	Clear, windy.

It will have been observed that the average temperature was higher, and the dew point consequently correspondingly lower during the time of the observations made on this plant in the

house than when exposed to the open air; this, no doubt, accounts for the fact that more was lost at night while indoors than when exposed, as may be seen by subtracting the amounts evaporated by day, in the table, from the whole amounts given off in twenty-four hours, the *average* at night having been 540 grains per night while indoors, and only 422 grains per night outside. Temperature and the relative humidity of the atmosphere would therefore seem to influence transpiration at night, the weather, apart from the conditions mentioned, having been about the same at night in the two cases. These results also show that the process is at least twice as active when the plant is exposed during the day as when kept in the house; and yet, as before intimated, the average temperature and the complement of the dew point were higher during the experiments made indoors than when the plant was out of doors. This would go to show that sunlight and currents of air are, one or both of them, great modifiers of this process.

It is interesting to notice that this plant evaporated 100 grains more than its own weight (4 ounces) in twelve hours.

Plant No. 4, *Hydrangea arborescens*, a shrubby plant in æstivating stage, 2 feet high; weighed, in a green state with roots cleaned, 4 ounces 250 grains; leaves alone, 2 ounces 250 grains; evaporating surface of leaves, 744 square inches; complete weight of plant fitted for experimentation, 7 pounds 11 ounces 240 grains.

It was found on taking up this plant, after the experiments had been made on it, that the quantity of earth its roots had to draw moisture from was rather too small, notwithstanding this circumstance, however, the results obtained are full of interest. They are the following:

Ex.	Place of experiment.	Duration of experiment.	Loss of weight by evapora'n	Loss by day, 12 hours.	Avera'e temper-ature.	Average dew point.	Weather.
I	In open air	Day and night	3010 gr.	2450 gr.	71.°	54.6°	Clear, windy.
II	"	"	2395 "	1910 "	71.	55.8	Clear, calm.
III	"	"	2425 "	1940 "	75.5	59.2	Clear.
IV	"	"	2515 "	2045 "	75.	57.5	Clear.
V	Indoors.	"	1460 "	975 "	79.	58.7	Clear.
VI	"	"	1370 "	900 "	80.	59.8	Clear.

In proportion to the extent of evaporating surface, this plant did not exhale as much as the Fuchsia; whereas the relation between the weights of the two plants, and the quantity evaporated by each respectively, is about the same. In the case of the

Fuchsia strong currents of air hastened the process, for while on the last day the Fuchsia was experimented with, the temperature was no higher and the difference between the dry bulb and dew point was not as great as on the previous day, it was found to exhale most—exceeding all the rest of the results by 92 grains. This latter excess, under the circumstances, must, in part at least, have been due to atmospheric currents, which were more prevalent on that day. The influence of these currents was still better exemplified by the results from the Hydrangea. It will have been noticed that this plant evaporated, at least an ounce more during experiment I. than on any succeeding day. The atmospheric currents no doubt produce their effect in a mechanical manner. They remove vaporized fluid as it is formed, and thus really act as a *vis a fronte* to the vaporizing liquid within.

Apart from the influence of winds, and given a clear day, a glance at the two last tables of results will show a direct correspondence between the complement of the dew point and the rate of transpiration in these cases. This latter fact will become more evident hereafter.

A few observations were made on the Hydrangea with the view of determining the rate of evaporation of different periods during the day. It was found that this plant while in the open air evaporated between the hours of 11 A. M. and 3 P. M. as much as in the remaining eight hours of the day's experiment.

Plant No. 5 was a *Camellia japonica*, a shrubby plant 28 inches high; leaf surface 479 square inches; complete weight of outfit ready for experiment, 8 pounds 12 ounces 40 grains.

The following results were obtained:

Ex.	Duration of experiment.	Loss of weight by evapora'n	Loss by day, 12 hours.	Av'ge temper-ature.	Av'ge dew point.	Place of experiment.	Weather.
I	Day and night	710 gr.	710 gr.	78.5°	63.3°	In open air	Clear. [rain.
II	"	650 "	650 "	79.5	71.3	"	Cloudy part, some
III	"	170 "	480 "	70.	61.5	"	Cloudy, clear at night
IV	"		240 "	74.	63.	Indoors.	Cloudy. [part.
V	"	10 "	190 "	74.	65.7	"	Cloudy and rainy in
VI	"	250 "	250 "	74.5	65.8	"	Clear.

These results exhibit in a satisfactory manner the connection between the character of the leaf structure and the rapidity of evaporation. The fact that this plant had leaves of dense structure and with thick cortical coverings must account for the very much smaller quantity of evaporation; and yet some allowance

ought to be made in this case for the less favorable meterological conditions during the time this plant was used, as shown by the table.

Again, it is very probable that in plants with evergreen leaves having thick epidermal tissue evaporation is only possible through the stomata, whereas in the case of leaves which are thin, soft and rapidly growing, with little cortical tissue, evaporation is more general from their surfaces. It is quite possible, also, that the number of stomata in the case of the Camellia is below the average. However these things may be, the fact remains, that the nature of the cuticular tissue of the leaves is hereby shown to be closely related to the amount of liquid transpired.

This plant exposed during a cloudy and dewy night gained in weight to the extent of 310 gr., as shown by the table; the same thing occurred on a rainy night in the house, when the plant was situated about four feet from an open window, as was the case in all indoor experiments; the gain in the latter case, as shown by the table, being 230 gr. There was no loss by evaporation at night in the open air.

Plant No. 6, was a Lantana (*L. carnosa*), a shrubby plant, 18 inches high; leaf surface 330 square inches; weight only 1½ ounces; complete weight fitted for experimentation, 5 pounds 2 ounces 250 grains.

The following are the results:

Ex.	Duration of Experiment.	Loss by Evaporation.	Loss by day, 12 hours.	Av'ge temperature.	Av'ge dew point	Place.	Weather.
I	Day nd night	1360 gr.	1200 gr.	66.°	52.2°	In open air	Clear, cloudy.
II	"	988 "	688 "	64.	54.4	"	Cloudy during day.
III	"	1820 "	1820 "	76.	63.3	"	Cl'r, windy dewy n't.
IV	"	2120 "	1920 "	79.5	65.6	"	Clear, windy day.
V	.....	.....	1930 "	79.	66.	"	Clear, windy.

The leaves of this little plant were very thin and soft, which may account, in a measure at least, for the great rapidity of transpiration from their surfaces. As compared to the extent of leaf surface, this plant evaporated more than any other plants tried, reaching, in a clear windy day, nearly 2 ounces per square foot of leaf surface in twelve hours. It will be observed that the Lantana evaporated nearly three times its own weight in twelve hours.

A few experiments were made with this plant (as was done with the Hydrangea) to ascertain how much more rapid the process was about midday than at other periods of the day. It was found

to be most rapid about noon and a little after; and it was found here, also, that half the quantity evaporated by day was given off between the hours of 11 A. M. and 3 P. M. These observations were made on clear days.

The last, or plant No. 7, was a Dracæna, an herbaceous plant with large leaves (being cultivated for its foliage). Its leaf surface was estimated at 817 square inches; its height 27 inches; weight not taken; complete weight of outfit, 11 pounds 6 ounces.

The following are the results obtained:

Ex.	Duration of experiment.	Loss of weight by evaporatn	Loss by day, 12 hours.	Aver'ge temperature.	Average dew point.	Place.	Weather.
I	Day and night	2784 gr.	2410 gr.	66°	52.2°	In open air	Clear.
II	"	1870 "	1385 "	64.	54.4	"	Cloudy, clear at night.
III	"	2601 "	2351 "	76.	63.3	"	Clear, during night.
IV	"	2670 "	2410 "	79.5	66.6	"	Clear, windy day, do.
V	"	2770 "	2520 "	79.	66.	"	Clear, much wind.

In comparison to the extent of leaf surface, this plant did not transpire as fast as most of the other plants used. The fact of the Dracæna having smooth and more or less hard leaves, no doubt accounts for the relatively less rapid evaporation from its surface. In the case of the two last plants tried, it may have been noticed, as in the two before them, that, other things being equal, dryness of the atmosphere was favorable to the process of transpiration.

In experiments IV and V, with both the Lantana and Dracæna, are shown once more the favorable influence of winds over this process in plants. The scales used in all these experiments were accurately adjusted.

Summary of Investigations.

In clear weather the evaporation by night as compared to that which takes place in the day appears to be about in the ratio of 1 to 5. In some cases no loss occurred on dewy or cloudy nights. The Camellia, however, lost nothing during clear nights, and gained in weight on dewy or rainy nights, even when kept indoors. Under ordinary circumstances evaporation at night was about the same indoors as in the open air.

The rate of transpiration during the day showed a very different relation, giving a ratio of 2 to 1 in favor of the open air. Of the whole amount evaporated during twelve hours, in the day experiments, half was given off between the hours of 11 A. M. and 3 P. M., as shown by repeated testing.

The following table, compiled for the number of clear days, will serve to exhibit the average rate of transpiration by day which took place in the open air during clear weather. It will also indicate the relation between leaf surface and the weight of the plant, and amount transpired.

The mean temperature and average dew point have also been recorded in the table.

No.	Name of Plant.	Duration of experiments	Average evaporati'n	Evaporating surface.	Weight of plant.	Average temp'ture.	Average dew point.
1	Calla.....	12 hours.	2850 gr.	All parts green	2 lb. 2 oz.	.....	.....
2	Geranium....	"	3500 "	....	4420 gr.	.....	.....
3	Fuchsia.....	"	1975 "	450 sq. in.	1920 "	64.5°	49.6°
4	Hydrangea ..	"	2858 "	744 "	2170 "	73.	56.7
5	Camellia	"	710 "	479 "	.....	75.5	63.3
6	Lantana.	"	1717½ "	330 "	720 "	75.1	61.7
7	Dracæna	"	2422 "	817 "	.....	75.5	62.

After an inspection of this table, the average rate of evaporation for soft, thin-leaved plants, in clear weather, may be put down at about 1¼ ounces per day (12 hours) for every square foot of leaf surface. The Lantana shows nearly 2 ounces to the square foot of surface. The Camellia, with its dense, smooth leaves, averaged less than half an ounce to the square foot of surface, per day.

The nature of the leaf structure modifies very greatly the rate of evaporation, as may be seen by comparing the results from the Camellia with those of other plants having soft and thin leaves.

Apart from structural peculiarities, no doubt the sun's rays stand first in importance among the modifying influences; for going back to the results from the Fuchsia, for instance, we find the average temperature higher and the dew point greater during the indoor experiments than when the plant was exposed, and yet the relation of evaporation in the two situations was, other things being equal, about as ordinarily the case. The same obtained in the case of the Hydrangea in a still more marked degree.

It is still an unsettled question whether radiation, as such, produces this great effect, or whether it is through the heat that accompanies the rays, or the chemical changes they produce.

That the difference between indoor and out of door evaporation was not due so much to atmospheric currents as to the action of the sun's rays, is shown by the fact that, during the ex-

periments outside on a cloudy day, strong atmospheric currents did not by any means raise the daily quantity to what it was on a calm but clear day. But it must be remembered that currents are much more effectual in hastening the process in clear than in cloudy weather, for the simple reason that the sun's rays opening the pores of the plant, allow of the more ready escape of aqueous vapor.

Of the influence of currents, then, it might be stated, from what has been observed, that in clear weather they are very effectual in favoring the process; in cloudy weather their influence is not so noticeable. On clear days strong currents increased the amount over that of calm days by about one-fifth or even one-fourth.

It was found, in every instance tried, that, other things being considered, the complement of the dew point, or the dryness of the air, modified in a marked degree the rate of transpiration; and this appeared to be, in a measure at least, independent of the temperature, as the latter condition did not seem to affect perceptibly the amount evaporated, unless, as is usually the case, the relative humidity was correspondingly low.

A few calculations may serve to impress the importance of the ratio of transpiration, deduced from these experiments. According to the above rate the Washington Elm, at Cambridge, a tree, it is stated, of no very large size, with its 200,000 square feet of leaf surface, would transpire 7¾ tons of watery vapor in twelve hours (day) of clear weather.

Carrying the calculation further, a grove consisting of five hundred trees, each with a leaf surface equal to that of the elm mentioned, would return to the atmosphere 3906 tons of aqueous vapor in twelve hours. Even supposing this to be much overestimated, it may very fairly be concluded from the facts given that the evaporation of watery vapor from plants is a powerful agent in maintaining the humidity of the surrounding air. And if the above data be correct, a strong argument is furnished in support of the belief that vegetation influences, in a great degree, the rainfall of a region of country.

The practical advantage of keeping plants in occupied rooms, in which the air is generally dryer than outside, has, also, from the results obtained, received further demonstration.

RAMBLES OF A BOTANIST IN NEW MEXICO.

BY EDWARD LEE GREENE.

I.

SANTA Rita del Cobre is situated in the extreme south-western part of New Mexico, amid the Santa Rita mountains, so rich in copper ore. It was in former times a Mexican penal colony where convicts did service in the mines; now, however, since the acquisition of that region by the United States, Santa Rita del Cobre has become a mere pile of adobe ruins; the crumbling walls, a group or two of neglected and very ancient looking peach trees, and the abandoned mines showing to him who passes through, that the place was not always the silent wilderness it now appears. New towns are at present springing up within a few miles, in different directions; for the American people have discovered rich silver mines not far from where the Mexicans found only the grosser and less valuable metal. It is an interesting region, the natural history of which has not been looked into except by the few scientists who have accompanied one or two government surveying expeditions in passing through it. Aglow with the ardor of a botanist in a new field of study, I entered this remote corner of New Mexico from the westward early in April. The broad expanse of plains through which runs the boundary line between this territory and Arizona was already decked with a profusion of flowers. The number of species was not great, but each species was represented by myriads of individuals, so that the whole prairie landscape seemed painted in lively colors. The plant most common of all was the smaller species of California poppy (*Eschscholtzia douglasii* Hook. & Arn.), one of the characteristic plants of the Pacific coast, hardly to have been looked for unless as a rarity so far eastward as this. In northern parts of California the Eschscholtzias sometimes grow in such abundance on the plains that sensitive eyes are dazzled and pained by the intense brightness of the mass of golden yellow bloom; yet never in California have I seen a landscape more brilliant with these flowers than were these level tracts away upon the borders of New Mexico. An albino variety, more pleasing than the normal yellow was frequently noticed, its petals not pure white but pale cream color, with a yellow spot at the base.

In fine contrast with the sun yellow of the California poppies, was the bright purple of a spreading Verbena, common here (*V. bipinnatifida* Schauer), a species which adorns the plains all along the base of the Rocky mountains from Mexico to the far northward. A blue flowered dwarf lupine (*L. brevicaulis* Wats.) was noticed in very sandy places, and two larger leguminous plants were conspicuous, not by their flowers which in both species were small, dull-purple, but by their large inflated pods. On one of them (*Astragalus diphysus* Gray) these pods were decidedly ornamental, being specked with dark purple, and looking almost like nests of birds' eggs as they lay in clusters on the sand, for the stems that bear them are nearly or quite prostrate. The other is also an Astragalus (*A. trifloris* Gray), producing almost white and very thin membranous pods of oblong shape. These when mature fall from the stem without opening to discharge their seeds, and are tossed about over the plains by every wind; sometimes lying in heaps under the lee of bushes and tufts of grass or other herbage. These harmless toys of the winds had, before I was accustomed to their ways, to my nerves, a singular little faculty of suggesting evil, the effect of which might slightly have amused a witness, had there been one. The weed gatherer on these plains needs to be always on the look-out for rattlesnakes; one of these reptiles may be lying coiled up under or near by any plant which he steps aside to examine or collect. The warning rattle is a sound he is familiar with. Now while he bends over some novel and interesting plant, absorbed in contemplating its peculiarities, or busily preparing specimens of it for his port-folio, let a passing breeze set in motion one of these bladdery capsules, and as it tumbles near with its detached seeds rattling within, ten to one he will be startled with the idea that a serpent is at his heels. The sound of the rattlesnake is very perfectly reproduced by the moving dry astragalus pod and seeds.

From these plains we pass gradually up to the highest lands of the low range, called the Burro Mountains, and are within an easy day's journey of the ruins of Santa Rita del Cobre, and equally near a number of new and lively mining camps. For a southwestern mountain chain the Burros are well watered and well timbered; that is to say, there are small springs and streamlets to be met with at intervals of a few miles, and their gentle slopes and rounded summits produce a scattered growth of oaks, pines

and cedars, all being peculiarly south-western species of rather dwarf and stunted habit. There is also a considerable variety of shrubs and herbaceous plants, making it altogether very interesting ground for the herbalist. The zest of botanizing in these hills was, however, a little tempered by fear of Indians. At the time of my journeying among them the Apaches were giving more trouble than usual, "on the rampage" as the settlers have it; sometimes riding up boldly to the lonely stage stations and driving off stock before the eyes of the solitary keeper; now and then shooting down upon the high road a helpless mail-rider for the sake of his pony, or an unprotected buck-board driver for his span of mules, and keeping all travelers and the few scattered settlers in a state of perpetual fear.

"Wagons close by?" asked the lone tenant of the one hostelry in the Burro Mountains, Carson by name, and nephew of the renowned "Kit," as port-folio in hand and haversack over my shoulder I came to his door a little before sunset. I answered that I knew of no wagons being on the road. "You come alone?" I replied in the affirmative, and volunteered at once such brief account of myself as would partly satisfy his manifest curiosity. "Well," said he, after a pause, and with an assumed air of calmest philosophy, "I reckon a man don't die 'till his time comes." The fact was the Apaches had made *him* a call only the day before, and driven away captive the horses that chanced to be grazing on the hillside opposite the door, and the man had not quite recovered from his fright. I, the luckier mortal, had leisurely botanized across a hundred miles of the infested region without having seen a savage. Nothing more formidable than Carson's pet turkey had I met with on all the road. This bird, a remarkably fine specimen of his species, assailed me furiously with beak and wings as soon as I came near the house. There are no domestic turkeys in the country, and this wild one had come to the ranch alone, of its own accord, when a mere chick, and that evidently with a mind to renounce forever the society of its kindred. Carson called the bird his dog, and assured me that he never failed by his loud cry of alarm to announce the approach of an Indian or any stranger, either by day or night. Both his antecedents and character seemed to me rather remarkable, and I record them here for the edification of the ornithological. At this stage-station I resolved to establish

myself for a day or two for the purpose of studying somewhat carefully the flora of the vicinity. In the early morning I wandered out among the picturesque rocky hills to find their sunny southward slopes covered with purple Phacelias (*P. crenulata* Torr.), scarlet Indian-pinks (*Castilleia integra* Gray) and many other plants less showy but more interesting to the botanist.

Hemispherical masses of a low-growing cactus with light scarlet flowers (*Cereus phœniceus* Engelm.) adorned the otherwise barren rocks away towards the summits, and here also in the shade of a lofty overhanging precipice, I detected, to my great delight, the handsome saxifragaceous shrub Fendlera (*F. rupicola* Eng. and Gray). It was hardly yet in flower; but a few weeks later in the more immediate vicinity of Santa Rita I saw it in perfection, its gracefully recurved branches resembling wreaths of large rose-colored, or sometimes nearly white flowers, interspersed with narrow green leaves. It is a beautiful bush, and one which from its home in the secluded mountain dells of the far south-west ought to be introduced to our gardens and made the associate of its much admired kindred, the Deutzia and the mock orange. I returned from this day's ramble bringing a port-folio well filled with rare plants, and in my hand a bundle of the thick leaf-stems of a stout-growing species of dock (*Rumex hymenosepalus* Torr.). The latter I handed to my good-natured, obliging host, with the request that he would have them made into a pie for my dinner. He looked at the stems suspiciously, at me enquiringly, and said *he* would have the pie made if I wanted to eat it and run all risks. This I agreed to. On the previous day, after having traveled from early morning until long past mid-day without water, I had pulled the root leaves of this fine-looking dock, eaten a considerable quantity of the thick, juicy and pleasantly tart petioles, and found them refreshing. I thought it worth while to try to demonstrate to these dwellers in a wilderness where there are no fruits, that in this common plant of the valleys around them they had a very tolerable substitute for rhubarb at least. Carson remarked that when the pie was taken from the oven it smelled nicely, but I could in no wise prevail on him to taste it. He was afraid the "weed" was "something poison."

As a Rumex or dock, this species is remarkable as growing not in wet places after the habit of most species of its genus, but often on dry plains, far from springs and streams, just where its

sour, juicy, refreshing stems might often be very serviceable to travelers if acquainted with its properties.

From the summit of the Burros the eastward slope stretching away for thirty miles, to the base of the Santa Ritas, descends so very gradually that the whole tract appears more like an elevated plain than like a mountain slope. The vegetation is that of the higher south-western plains, there being no trees, few bushes, in fact not much but grasses and numerous species of the vast genus Astragalus. The Astragali that grow here (*A. mollissimus* Torr.; *A. missouriensis* Nutt.; *A. humistratus* Gray; *A. cobrensis* Gray; *A. shortianus* Nutt., and *A. nuttallianus* Gray) are mostly very handsome sorts, with more or less white, silky foliage, and fine racemes of rich violet, or pink, or purple flowers, quite different from the rattle-podded things of the same genus which occupy the plains at the western base of this same range of hills.

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RECENT LITERATURE.

LeConte's Geology.[1]—The body of this work is divided into three parts, treating respectively of dynamical, structural and historical geology. The author devotes the large space of 160 pages to the consideration of the dynamical agencies concerned in producing crust-modification. Atmospheric, aqueous, igneous and organic agencies are successively considered. Erosion due to rain and rivers, the action of waves and tides, glacial action, chemical agencies, each receive a full share of attention, with good illustrations. The subject of earthquakes and volcanoes is fully and elaborately discussed and the great geyser district of the West receives more attention than has been devoted to it hitherto in any popular work. The illustrations of the great geysers, from the Reports of Hayden's Survey, give the book a freshness that will be appreciated by all American students. The section devoted to the consideration of reef-formation is full of valuable matter with well chosen illustrative diagrams, as is also that on faunal and floral distributions.

The hundred pages devoted to structural geology is an unusually large proportion for this subject, but the many varieties of faulting and unconformability due to various causes, and which are calculated to puzzle the young geologist, require the full elucidation which they receive in the work.

[1] *Elements of Geology.* A Text-book for Colleges and the General Reader. By Joseph LeConte, Professor of Geology in the University of California. 903 illustrations. 8vo, pp. xiii, 588. D. Appleton & Co., New York, 1878. Price $4.50.

To the historical part the author devotes about 300 pages, which, as he informs us in the introduction, has been considered throughout from the standpoint of the evolution hypothesis. This is a new and commendable feature in an American text-book, as previous authors have made it only a secondary matter.

The earlier floral and faunal characteristics of the American continent are illustrated by well chosen figures from the works of Dawson, Hall, Meek, Worthen, Gabb, and others. The carboniferous flora receives a large share of attention, with many figures from Dawson and Lesquereux. Some of the figures of vertebrate remains are not as good as they might have been; some, as those of *Glyptodon*, *Megatherium* and the head of *Sivatherium*, are restorations made before enough of the skeleton was known to make exact figures, which have since been superseded by more recent studies from more perfect material.

The value of this part of the work is somewhat curtailed by the use in some instances of a nomenclature which is not used by European or many American palæontologists. As examples we cite the names *Edestosaurus*, *Tylosaurus*, *Lestosaurus* and *Dinoceras*, which have never been distinguished from genera previously named, and *Brontotherium*, which there can be but little doubt is the same as the genus long since called *Titanotherium*, by Leidy, and still earlier *Menodus* by Pomel.

FOSTER'S PHYSIOLOGY.[1]—In introducing advanced students to the study of physiology, Mr. Foster starts from a description of the Amœba and its physiology, and having described the vital qualities of the protoplasm of an Amœba, he leads the reader to study the vital qualities of the higher animals, which, as taught by morphological studies, "are in reality groups of Amœbæ peculiarly associated together. All the physiological phenomena of the higher animals are similarly the results of these fundamental qualities of protoplasm peculiarly associated together. The dominant principle of this association is the physiological division of labor corresponding to the morphological differentiation of structure. Were a larger or 'higher' animal to consist simply of a colony of undifferentiated Amœbæ, one animal differing from another merely in the number of units making up the mass of its body, without any differences between the individual units, progress of function would be an impossibility. The accumulation of units would be a hindrance to welfare rather than a help. Hence, in the evolution of living beings through past times, it has come about, that in the higher animals (and plants) certain groups of the constituent amœbiform units or cells have, in company with a change in structure, been set apart for the manifestation of certain only of the fundamental properties of protoplasm, to the exclusion

[1] *A Text Book of Physiology*. By M. FOSTER, M.A., M.D., F.R.S., Prælector of Physiology and Fellow of Trinity College, Cambridge. London: Macmillan & Co., 1877, 8vo, pp. 559.

or at least to the complete subordination of the other properties." This extract from the introductory chapter strikes the keynote to the method of treatment of the subject. It is without doubt, and we have the word of a competent physiological expert for it, the most compact, clear and advanced text book of physiology in the language. The style is simple, clear and concise, and the preface is written in a happy vein with a dry humor that is unexpected but not the less telling and forcible. The book is designed chiefly for medical students, who have already mastered Huxley's Elementary Lessons in Physiology. We think the book would have been improved by the addition of more illustrations than there are; not perhaps of machinery, but giving the results of important physiological experiments. The chapters on the Fundamental Properties of Nervous Tissues, and the Brain, are particularly good.

SEMPER'S EYES OF THE VERTEBRATE TYPE ON THE BACK OF SNAILS.[1]—This work gives the results of Professor Semper's extensive and brilliant researches on the small organs of sight, or eye-specks, scattered over the back of a shelless snail (*Onchidium*) of which he has examined nineteen species, some of them living in the Philippine islands. In the author's opinion these eye-specks have almost all the elements of the vertebrate eye. These eyes are different in structure from the tentacular eyes of the Onchidium and other land snails, as the nerve arising from them are not thrown off from the cerebral ganglion, but from the visceral nerve-centre. Prof. Semper describes the arrangement, size and number of the dorsal eyes, with their structure, and gives remarks on their developmental history; a comparison of the dorsal eyes of Onchidium with those of other animals, discusses the biological considerations resulting from these facts, and in the closing remarks of a theoretical nature, discourses on the primitive origin of dorsal eyes, and on the "Monophyletic or polyphyletic advance in the formation of the simplest dorsal eyes." We can bear witness to the beauty of the microscopic sections, having glanced at some of them through the kindness of Professor Semper during his visit in the United States last autumn. The plates are colored lithographs, and are effectively and skillfully drawn.

ZIRKEL'S MICROSCOPICAL PETROGRAPHY.[2]—This subject has in the hands of Zirkel, Boricky and others in Germany and Austria, attained a good degree of development, but little attention

[1] *Reisen im Archipel der Philippinen*, von Dr. C. SEMPER. Zweiter Theil. Wissenschaftliche Resultate. Drittu Band. Land-Mollusken. Ueber Seh organe vom Typus der Wirbel thier augen auf dem Rücken von Schnecken. Von Dr. C. Semper. Mit fünf Tafeln Colorirter abbildungen, Wiesbaden, 1877. 4to, pp. 46.

[2] *United States Geological Exploration of the Fortieth Parallel.* Clarence King, Geologist-in-Charge. Microscopical Petrography. By FERDINAND ZIRKEL. Illustrated by twelve plates. Washington, 1876. 4to, pp.

having been bestowed upon it in England, except in a slight way, we believe, by Forbes and Sorby; in this country it has suffered almost complete neglect, though undoubtedly a few will by this volume be stimulated to special research in a department promising interesting results. The present volume will therefore form the starting point, a basis of comparison for future American microgeologists. Mr. King and his assistants, Messrs. S. F. Emmons and Arnold Hague, made large collections of crystalline rocks along the Fortieth Parallel in the western United States. Professor Zirkel was invited to New York to make a preliminary examination of the collection, thus becoming acquainted with the geological distribution, relative age and reciprocal connections of the rocks, so that their minute chemical and mineralogical constitution has been made from a geological view, greatly enhancing the value of Zirkel's labors. At home the author carefully studied more than twenty-five hundred thin sections of these rocks, crystalline or of volcanic origin, and he pays Mr. King the compliment that "your original designations should almost never be altered or corrected." The plates are excellent and well colored.

Bulletin of the Buffalo Society of Natural Science.—Amongst the valuable papers contributed to volume III. 1877, we notice more especially those by Grote and Pitt on the Crustacea of the Water-Lime Group of Buffalo; On Texan Lepidoptera, by L. F. Harvey; also papers on Lepidoptera by Grote and Scudder, and a list of North American *Syrphidæ* by C. R. Osten Sacken. There are two papers on the Hyphomycetous and Discomycetous Fungi of the United States; an article concerning the Fishes of the Ichthyologia Ohioensis, and a Check List of the Fishes of the Fresh Waters of North America. The last paper is the joint production of Prof. Jordan and H. E. Copeland, and is a valuable contribution to our ichthyological literature, bringing together material which has heretofore been scattered through a great variety of documents. Archæological papers by Dellenbaugh, Howland and Grote are also worthy of notice. The Bulletin presents a make-up and typographical accuracy worthy of all imitation. We observe that the positions of Director of the Museum and Chairman of the Publication Committee are still filled by Mr. A. R. Grote.

Bulletin of the United States Geological and Geographical Survey of the Territories.[1]—This last number of the Bulletin is of varied interest, reflecting the breadth of view that characterizes the administration of the survey, and the efficiency of its editor, Dr. Coues. There are articles on *Mammalia* and birds, among which we notice one on the ornithology of the lower Rio Grande valley, by Mr. Sennett, who enumerates several species, which Dr. Coues determines to be new to our political limits. A

[1] Vol. IV. No. 1. F. V. Hayden, Geologist-in-Charge.

very important paper by Mr. Ridgway characterizes the families of the *Herodiones*, and the subdivisions and genera, chiefly of the *Ardeidæ*. The precision of definition exhibited in this paper gives it a first rank in scientific work of its kind, offering an example worthy of imitation in all departments. We observe, however, that the learned author thinks it necessary to employ generic names for groups characterized by size and color, and forms of feathers which are sometimes only seasonal, and sometimes very slightly differentiated, a custom which is not adopted by students of other classes of *Vertebrata*. Dr. Coues furnishes interesting accounts of the consolidated hoofs of certain individuals of *Cariacus virginianus* and *Sus scropha*. His conclusion regarding the latter is stated in the following rather too highly figurative language: "The upshot of this modification of the foot is, that a strictly artiodactyle animal is transformed into an imperfectly perissodactyle one. As far as the hoof is concerned the pig is completely solidungulate." There are entomological articles by Messrs. Scudder, Grote and Chambers, and two palæontological ones by Prof. Cope. One of the latter is a reply to Prof. Owen's criticism of Prof. Cope's writings on the Pythonomorphous reptiles. An article by Drs. Coues and Yarrow gives useful information regarding the geographical distribution of Batrachia and reptiles of Dakota and Montana. But we cannot see why the authors should again describe the dentition of the genus *Crotalus*, and the well-known characters of the teeth of *Heterodon*, which may be found in any of the general herpetological works. The distribution of the *Eutænia proxima* is erroneously given as extending over the entire United States west of the eastern region. Its range is N. E. Mexico, Texas and part of the Mississippi Valley.

RECENT BOOKS AND PAMPHLETS.—Die Cœlenteraten, Echinodermen und Würmer, der K. K. Osterreichisch-Ungarischen Nordpol Expedition. Von Dr. Emil v. Marenzeller. Wien 1877. 4to, pp. 42.

Darwin; or God in Nature. By Robert McK. Ormsby. Second Edition. New York. Masonic Publishing and Furnishing Co. 1878. 12mo, pp. 69.

Brehm's Thierleben. Band iii, Heft 9–14 vii. 1–2. Leipzig, 1878. New York: B. Westermann & Co. 8vo. 40 cents a Heft.

Twelfth Annual Report of the Commissioners on Inland Fisheries for the year ending January 1, 1878. Boston. 1878. 8vo, pp. 64.

Proceedings of the Boston Society of Natural History. Vol. xix. Part II. Boston. 1877. 8vo, pp. 111.

Notes on the Mineralogy and Petrography of Boston and vicinity. By M. Edward Wadsworth. (From the Proceedings of the Boston Society of Natural History xix.) 8vo, pp.21.

Fifth and Sixth Annual Reports of the Curators of the Museum of Wesleyan University. Including a History of the Museum from its Formation. Middletown, Con. 1877. 8vo, pp. 26.

A List of the Species of the Tribe Aphidini, family Aphidæ, found in the United States, which have been heretofore named, with descriptions of some new species. By Cyrus Thomas. (From Bulletin No. 2, Ill. State Lab. of Nat. Hist.) 8vo, pp. 14.

Report on the Geological and Geographical Survey of the Rocky Mountain Region. By J. W. Powell. Washington, D. C. 1877. 8vo, pp. 19.

GENERAL NOTES.

BOTANY.

DAVENPORT'S NOTES ON BOTRYCHIUM SIMPLEX.[1]—In 1821, the late President Hitchcock collected at Conway, Mass., specimens of a fern which he at first referred to *Botrychium lunaria* Sw. Two years later, however, he published in Silliman's Journal, a description of the species, giving to it the name of *Botrychium simplex*. That the species has had an uncertain place in pteridography, is evident from Mr. Davenport's account of its drifting in different editions of one work from *B. virginianum*, Sw., to *B. lanceolatum*, Angs., to *B. matricariæfolium*, A. Br. Part of this confusion is suspected by Mr. Davenport to have arisen from the fact that President Hitchcock really collected two distinct species, namely, *B. matricariæfolium* and *B. simplex*. This supposition is rendered the more probable from the occurrence of the two species in the vicinity of the original station.

In clearing up the matter, the author has appeared to avail himself most patiently of every means of discrimination in his power. A critical examination of all the specimens known to him to have been hitherto collected for *B. simplex*, is followed by an analysis of a portion of Milde's monograph of the genus Botrychium, and by diagnosis of *B. simplex* and *B. matricariæfolium*. Mr. Davenport's studies were carried on without a knowledge of Milde's paper, and his conclusions independently reached are the same as those held at one time by Milde. These may be stated as follows, in a translation of Milde's words:

"The characteristics of *B. simplex* lie:—

"1st. In the stalked sterile frond approximate to the rhizoma.

"2d. In the unsymmetrical segments of incomplete half-lunate forms.

"3d. In the kind and manner of the evolution of the forms."

Mr. Emerton's figures given in this work exemplify the above characters very fully. To this may be added the peculiarities of the spores. *B. simplex* has large spores closely covered with small points, never with warts.

B. matricariæfolium has spores which are thickly covered with large warts.

Mr. Davenport states in his prefatory note that "if the publication of these notes shall prove to be of any service to fern-students, they will owe it entirely to the generosity of Mr. Robinson." We have only to add to our notice the single remark that the typographical execution and the plates are of superior excellence, to indicate to our readers the indebtedness of fern students to both Mr. Davenport and Mr. Robinson.—*G. L. G.*

MOVEMENT OF AN AQUATIC SUBMERGED PLANT.—M. Rodier has recently made some interesting observations on the rhythmical movements of a well-known water-plant, *Ceratophyllum demersum*.

[1] *Notes on Botrychium simplex* Hitchcock. By GEORGE E. DAVENPORT, 1877. (22 quarto pages, with two plates, privately printed.)

The branches of this plant present two different aspects. Sometimes the whorls are very close to each other, the internodes being very short, and the leaves of the consecutive whorls resting on each other, make with the stem a very acute angle and form a compact mass. In other cases the internodes are elongated, the whorls more distant and the leaves become more and more nearly at right angles to the stem, until at length some of them actually point downwards. It is this last form which displays in the most striking manner the movements here described. Taking the axis at the moment when it is nearly erect, it is seen to bend regularly, curving more and more for about six hours, when it reaches its maximum of flexion; then straightening itself more slowly, it resumes its original position in about twelve hours. It next bends in a direction opposite to its first flexion, and in four hours it attains its maximum of inverse flexion, resuming its first position again in four hours. The total duration of an evolution is hence about 26 hours. Thus a young branch is vertical at 6 A. M., attains its maximum of flexion at noon, is again perfectly erect at midnight, attains its maximum inverse flexion at 4 A. M., and is again vertical at 8 A. M., etc. If examined carefully under favorable conditions it is seen that the movement of flexion takes place first in the higher or younger internodes, advancing thence with diminished intensity from above downwards; while, on the contrary, the movement of erection commences with the lower or older and ends with the upper internodes. The oscillations continue very apparent during several days, diminishing usually at the end of a certain time. Light does not appear to have any influence on the movements, which were carried on with as much vigor when the light was partially or entirely cut off, when it was thrown by means of a mirror from the opposite direction, or when it was made to pass through red glass. M. Rodier was unable to detect that the leaves have any motion of their own, independent of that of the stem.—*A. W. Bennett.*

The Eucalyptus in California.—Last season the Central Pacific Railroad Co. planted 300,000 gum trees on the lines of their roads. This winter they intend to set out 700,000 more. Those set out by the Company around their shops in Sacramento last season having made such rapid and healthy growth, the Company are now planting 2,000 additional trees, placing them in every available nook and corner around the works and along the track by the slough.

Germination of Acorns.—In this place (Lansing, Michigan) white oak acorns germinate in autumn. The radical pushes out and down into the leaves or soil often for three inches or more. The petioles of the cotyledons grow out from the shell about half an inch. This enables the plumule to find plenty of room to start in spring. It is quite common to find two embryos in one acorn, and three embryos are not very rare.—*W. J. Beal.*

ABSORPTION OF WATER BY ROOTS.—Vesque gives the following results of his experiments:

1st. The absorption of water by roots is not proportionate to the temperature of the leaves when the latter are surrounded by an atmosphere not saturated with moisture. At low temperatures it increases only slightly as the temperature rises; but at a certain degree fixed for each plant absorption increases rapidly, and at a maximum temperature becomes stationary; this maximum varies in different species.

2d. The absorption of water by roots is independent of the temperature of the leaves when these are surrounded by a saturated atmosphere, in the dark, and protected from calorific radiation.

3d. Calorific radiation in the dark acts in a very energetic manner upon transpiration in saturated air, and produces upon absorption the same effect as an elevation of temperature does upon leaves which are in dry air.—*From Annales des Sciences Naturelles, September*, 1877.

ZOÖLOGY.[1]

HOMOLOGIES OF THE EAR-BONES OF MAMMALS, ETC.—Professor G. Baraldi, in the *Atti della Societa Toscana di Scienze Naturali*, of Pisa, for 1877, has a paper on the homologies of the organs accessory to respiration in fishes, and the organs of hearing in the higher vertebrates, with special reference to the homologies of the branchiostegal and opercular bones of fishes, the tympanic bones and cartilages of the ear-conch of mammalia. A plate and tabular synopsis which accompany the paper show that he regards the hyomandibular of fishes, the columella of amphibia, reptiles and birds as homologues of the stapes of mammals; and the symplectic of fishes, suspensory cartilage of amphibia, ossicle of the tensor tympanica of reptiles and birds as homologues of the orbiculon or lenticulon of mammals. The bone homologous with the incus of mammals, are the quadrate (Gegenbaur), tympanic (Owen) of reptiles and birds; the quadrate or suspensorium of amphibia, the quadrate, hypotympanic, jugal, hypocotyleal, os quadrato-jugal as it has been variously called, of fishes. The articulare of fishes, amphibians, reptiles and birds are homologues of the mammalian malleus. The branchiostegal rays of fishes, the cartilaginous tympanic ring of amphibians, without homologue in reptiles and birds, is homologous with the tympanic ring of mammals. The interoperculum of fishes (no homologues in amphibians, reptiles and birds) is homologous with the annular or tubiform cartilage of mammals. The opercular of fishes, homologues wanting in amphibians, reptiles and birds, is regarded as homologous with the cartilaginous ear-conch of mammals. The sub-operculum of fishes (homologues absent in amphibians, reptiles

[1] The departments of Ornithology and Mammalogy are conducted by Dr. ELLIOTT COUES, U. S. A.

and birds) are regarded as the homologue of the scutiform cartilage in mammals.

It will be noticed upon comparison with Huxley (*Anatomy of Vertebrates*) that while the latter author divides the otic bones in mammals between the hyoidean and mandibular arches, Professor Baraldi puts the malleus (articular), the incus (quadrate), the orbiculare and stapes (columella), all in the mandibular arch. The differences between the two authorities on the homologies of these parts in other forms consists mainly in this, that Baraldi puts the stapes, columella and orbiculare into the mandibular arch in all the forms, while Huxley relegates them to the hyoidean. The studies are all from actual subjects.

TERRESTRIAL MOLLUSCA OF TEXAS.—During a recent visit to Texas the writer had an opportunity of making quite an extensive collection of the land shells, and a still more interesting collection of the *Reptilia* and *Batrachia*. The land shells exhibited a few peculiar characters which would be of interest if fully discussed. The species discovered were as follows:

1. *H. thyroides* Say; two varieties, one of which has the umbilicus closed. This variety was the only one occurring at Orange and Beaumont, on the Texas and New Orleans Railroad, one hundred miles east of Huston. At Huston only the typical species was found. Mr. Bland, who has kindly examined these shells, suggests that the non-umbilicate variety is the *H. bucculenta* Gould.

2. *Zonites friabilis* W. G. Binney. Typical; rare, under bushes at Orange.

3. *Helix monodon* Racket; a small, elevated variety, under logs in pine woods.

5. *Bulimulus alternatus* Say. Common under bushes in prairies.

6. *Helix mooreanus* W. G. Binney; "considered a variety of *H. tholus*." (Bland.)

7. *Helicina tropica* Jan.

8. *H. berlandieriana* Moricand. This shell occurred in great abundance in the grass, on a sandy bluff of the bayou at Huston, associated with the *H. triodontoides* Bland, and *H. thyroides* Say. In this situation the shells were almost totally without cover, a circumstance somewhat anomalous.

9. *H. texasiana* Moric.; abundant under logs, bark, stones, etc.

10. *H. espiloca* Ravenel; abundant at Orange, and also at Brashear City, La., under bits of bark, boards, small sticks, etc.; even in the door-yards of private residences. Associated with it was *Helix pulchella* Müll., and *Pupa pentodon* Say, at Brashear City.

11. *Helix vultuosa* Gould, "typical," (Bland). With this was found, at a place twenty miles north of Beaumont, in Hardin

County, a very curious variety, which differs, materially, and for which I propose the name of *H. copei*, or *H. vultuosa* variety *copei*, and of which the following is a description:

Shell reddish, somewhat thin, deeply striated by lines of growth, and of medium size. Spire somewhat depressed in some specimens, slightly more elevated in others. Whorls five, transversely striated with oblique lines of growth, and increasing very gradually and regularly in size; a faint carina appearing at the junction of the upper third and lower two-thirds of the body-whorl, from which the latter tapers inwardly to the base of the shell. Sutures regularly and moderately impressed. Peristome sub-acute, and broadly reflected outward and downward at its lower two-thirds, and bearing on its basal third an acute carina, within which is seen a prominent, vertical, double tooth, of which the outer portion is the larger. A second tooth is carried by the inner margin of the peristome at the centre of the body-whorl, the point of which is in close relation to an arcuate tooth carried by the parietal wall of the aperture. Umbilicus wide, exhibiting most of the volutions. Height 7 mm. Lesser diameter 12 mm. Greater diameter 14 mm. This size is about the average.

This shell differs from the *H. vultuosa* Gould, to which it is closely allied, and of which it is perhaps but a very distinct variety, in the following particulars: It is a larger shell but of lighter texture. The lines of growth are more deeply impressed, though this character might not be constant in a larger number of specimens. The lip is much more broadly reflected below, with a sharper central angle, and much more produced outwardly, at the point of junction of the upper third with the lower two-thirds. The umbilicus is much wider, exhibiting the volutions more plainly. The arrangement of the teeth is very distinct in the two species or varieties under consideration. This shell I collected under logs in pine woods, twenty miles north of Beaumont, in Hardin County, Texas, where it was associated with the *H. bucculenta* Gould, *Zonites intertextus* Binney, *H. monodon* Racket, *Helicina tropica* Jan., *Zonites demissus* Binney, and *Zonites arboreus* Say. I dedicate the shell, with great pleasure, to my friend, Prof. E. D. Cope.

The specimens of *Z. intertextus* and *Z. demissus* were very large, and some of the latter exhibit the peculiarity of bearing an indistinct carina.—*W. G. Weatherby.*

A Strange Flight of Hawks.—A very curious phenomenon occurred in this neighborhood during the last week in September. A number of trustworthy persons who witnessed the sight all give the same facts. Near Middle river, about sixteen miles south of Fulton, thousands of large hawks were seen circling just

above the trees. After they reached the creek near A. T. Williams' farm, large numbers of them lit in the trees and collected close together. Parties with shot-guns went in among them and killed a number, but the hawks seemed tired and determined to rest, and the firing failed to put any considerable number of them to flight. Those that did fly soon settled down again. After resting about three hours they rose again, forming great circles often interlacing each other, and pursued their flight toward the south. The specimens killed and examined show that they were not quite so large as hen-hawks, and they were not prairie-hawks. R. W. Maid, who witnessed this extraordinary sight at a point some eight miles distant, says they were "quail-hawks," and that as the quails begun to leave the country, they were in pursuit. Many of the hunters who were out looking for birds tell us that they saw hundreds of quail in the immediate neighborhood of the hawks, but they refused to fly, and ran, as if in terror, to the thickest parts of the brush. That there were an immense number of hawks is shown by the fact that no one could see them all at once, though they were flying very high; and by the fact that they were seen at about the same hour by persons eight and ten miles apart.—*California paper.—Communicated by R. E. C. Stearns.*

A Texan Cliff Frog.—G. W. Marnock has recently discovered in south-western Texas a new species of the genus *Lithodytes*, which Prof. Cope calls *L. latrans*. It lives in fissures in the limestone cliffs that stretch across that section of the state. According to Mr. Marnock the eggs hatch out in the winter, and the tadpoles live in the rainwater which is caught in the shallow holes in the rocks, far from the creeks. During the winter the adults are very noisy, the rocks resounding in the evening with their dog-like bark. The noise is supposed by the country people to be made by lizards, especially the *Gerrhonotus infernalis* which occurs in the same region. *Lithodytes* Cope, embraces many other species, from Mexico and South America. It is referred to the *Cystignathidæ*.

Occurrence of the Phyllopod Eubranchipus in winter.—Specimens of adult male and female *Eubranchipus vernalis* Verrill, were brought, on January 10th, into the Museum of the Peabody Academy of Science, from Danvers, Mass., by Mr. John H. Cook. Mr. John Sears, an observing man, who saw these specimens, assures me that he has found similar ones in Danvers in early winter (December) when the ice is forming. It has also been observed by Mr. J. S. Kingsley and myself at Salem, Mass., April 12th, and there is now no reasonable doubt but that this species attains it maturity in the autumn from eggs dropped by the females in the spring, and it is probable that most of the species of this family attain their development late in the summer and early in the autumn.—*A. S. Packard, Jr.*

ANTHROPOLOGY.[1]

ANTHROPOLOGICAL NEWS.—Mr. F. W. Putnam, in the *Nation*, for January 3d, reviews Mr. Prime's work on pottery with reference to the north-west coast of America. Sabin's *Bibliotheca Americana*, which most of our readers know to be the standard authority upon books relating to America, has reached its fiftieth number with the word Jamaica.

Dr. Georg Fischer, of Freiburg, contributes to *Archiv für Anthropologie, &c.*, 1877, III, an able paper upon mineralogy as an auxiliary to archæology. Some months ago this distinguished author published a work upon the same subject, at the same time calling upon those who are interested in the matter to send him fragments of jade implements, or their shavings removed from the unsculptured side with a diamond saw. The article above alluded to gives especial attention to Mexican jades.

Dr. Gustav Brühl continues his brochures entitled "Die Culturvölker alt-Amerikas," Part V–VII, relates to monuments and antiquities in Colombia, Peru, and the valleys of the Colorado and Rio Grande; Part VIII to writing; and Part IX to chronology. Issued from New York, Cincinnati and St. Louis.

From January 15th to March 1st, in the halls of the Louvre set apart for the exhibition of antiquities, the anthropological specimens collected in South America, by explorers sent out by the French government, will be displayed. On the eighth of January, Mr. C. C. Jones, of New York, made a communication to the Lond. Anth. Inst. upon American bird-mounds. Mr. Wm. Owens contributes to *Lippincott's Magazine* for January an article on the Folk-lore of the Southern negroes.

ABROAD.—The dying out of the Polynesian races, Sir David Wedderburn in *Fortnightly* (*Popular Science Monthly*, Supplement, III); The Races of the Danube, John Fiske in *Atlantic Monthly*, April; Beiträge zur physischen Anthropologie der Deutschen, Virchow in Abhandlungen der Konigl. Academie zu Berlin; the first six parts of the Mittheilungen der Anth. Gesellschaft in Wien, contain very able articles upon Contemporaneity of Men with the Cave-bear in Mähren, On the use of stone weapons indicated by certain expressions in the German language, On Terramares in Hungary, A new domestic dog of the bronze period, Trepanation, Perforation of Stone implements, The Archæological Commission of St. Petersburg, &c.; Man and the Glacial Period, Thomas Belt, *Popular Science Monthly*, Nov.; Land und Leute im Seegebiete Australiens, *Aus allen Welttheilen*, Nov., 1877; On the Malays and Polynesians, Rev. S. J. Whitmee before the Anthropological Institute, Nov. 27th; Discussion upon the evidence as to the Antiquity of Man in Great Britain, in Journal of the Anthropological Institute for Nov. (an exceedingly

[1] Edited by Prof. OTIS T. MASON, Columbian College, Washington, D. C.

valuable number); Les Kourganes de la province de Saint Petersburg, and Sculptures préhistoriques situeés sur les bords des lacs des Merveilles, *Matériaux* viii; Chronometres fournis par la géologie pour mesurer l'antiquité de l'homme; Congres Archéologique de France, and Sur le Traitement des Morts chez les Peuples aryens primitifs, *Matériaux* ix.

Prof. Edward S. Morse has found traces of pre-historic man in Japan. Near a station on the railroad to Tokio, called Omori, are shell-heaps composed of shells of various genera, such as Fusus, Eburnea, Turbo, Pyrula, Arca, Pecten, Cardium and Ostrea. The heap examined is 200 feet wide, and from 1 to 6 feet deep. Over this is a deposit of earth three feet thick. Fragments of bone, implements of horn and pottery were found. While the mass resembled similar structures found in New England by Prof. Morse, the prevailing characteristics were the immense quantity of pottery and the absence of bone implements and of flint flakes. On account of the distance from and elevation above the shore, the absence of stone implements, and the great thickness of the beds above, the Professor supposes the deposit to be of great antiquity.—*O. T. Mason, Washington, D. C.*

GEOLOGY AND PALÆONTOLOGY.

The Geological Survey of New Zealand is pursuing its labors with much success under the able management of its director, Dr. Jas. Hector. This gentleman gives the thickness of the strata from the Carboniferous to the Lias as over 18,000 feet. The beds have south dips, are full of joints, and exhibit two great stratigraphical breaks. They present seventeen fossiliferous horizons. A remarkable feature of the palæontology is the low range of *Belemnites* and the high range of long-winged *Spirifers*. Some huge saurians occur at one of the horizons.

A new genus of Dinosauria from Colorado.—A form of this order has recently been discovered in the Dakota Beds of Colorado by Mr. Lucas, which is quite different from those already announced. The vertebræ resemble those of typical *Dinosauria* in their solidity and slightly amphicœlous extremities, and in the wide discoidal form of the proximal caudals, but differ from them in the extraordinary elevation of the dorsal zygapophyses, which stand on a stem composed of the neurapophyses. The anterior zygapophyses of the dorsal vertebræ are united on the middle line, forming a basin which receives the posterior zygapophyses. This is not the case in the anterior caudals, where the zygapophyses have their usual position, and the summit of the neural spine is expanded transversely. This genus has been named by Prof. Cope, *Hypsirophus*, and the species *H. discurus*. The dorsal vertebra of the latter measures m. .105 to the base of the neural arch, and m. .300 to the middle of the

faces of the posterior zygapophyses. The centrum is m. .105 wide. The caudal centrum is m. .175 wide; and m. .160 high. The neural arch and spine are m. .575 high, and the latter m. .040 wide at the base, and m. .130 wide at the summit. The species was as large as *Hadrosaurus foulkii*. It is not impossible that it may be the same as the *Lælaps trihedrodon* Cope. The femur of this species recently discovered has very nearly the characters of that of the *Megalosaurus bucklandii*, and is quite different from that of *Lælaps*; hence, if not a *Hypsirophus*, the *L. trihedrodon* must be referred to *Megalosaurus*.

A NEW DEER FROM INDIANA.—John Collett, of the Geological Survey of Indiana, discovered in a late lacustrine deposit in Vandenburg Co., Indiana, a number of post-pliocene fossils. One of these is the ulno-radius, etc., of a *Bos*, and another is the left mandibular ramus of a deer, probably of the genus *Cariacus*. The jaw differs in its proportions from those of *C. virginianus*, *C. macrotus* and *C. columbianus*, with a considerable number of which I have compared it. It belonged to an animal of the average size of the *C. virginianus*, but differs in having the diastema an inch or more longer, while the tooth line is shorter. Placing the first molars in line, the last molar of the fossil form attains only the penultimate column of that of the *C. virginianus*; in some cases just a little further. On the other hand, the angle of the mandible extends beyond that of the *C. virginianus*, and the slope of the anterior base of the coronoid process is more gradual. At the same time this portion is less oblique in the transverse direction, owing to the prominence of the external face of the ramus. This ramus differs also in the great prominence and anterior position of the posterior edge of the masseteric fossa, which leaves behind it a wide oblique face, little developed in the existing species. The species being clearly new, I call it *Cariacus dolichopsis*.—*E. D. Cope.*

GEOGRAPHY AND TRAVELS.

THE BRITISH POLAR EXPEDITION. EXTRACT FROM SIR J. D. HOOKER'S ADDRESS AS PRESIDENT OF THE ROYAL SOCIETY—The President then passed on to a review of the scientific results of the Polar expedition, which he said in his judgment, especially the biological results, appeared to have quite come up to our expectations. Considering that but one season was available for collecting and observing (and we all know how short that is in the Arctic regions), the results are indeed most creditable to the gentlemen who contributed them. Geology has proved by far the most prolific field of research. Perhaps botany comes next. The researches in this department, and on the insects which have been worked up by Mr. M'Lachlan, prove that between 80 degrees and 83 degrees north, in Grinnell's land, the conditions for the

existence of these organisms are far more favorable than are those of lands a long way to the southward. The flora of the series of channels between 80 degrees and 83 degrees north, the shores of which have been botanized by the officers of the Polar expedition, have yielded upwards of 70 flowering plants and ferns, which is a much greater number than has been obtained from a similar area among the Polar islands to the south-westward, and is unexpectedly large. All are from a much higher latitude than has elsewhere been explored botanically, except the islets off the extreme north of Spitzbergen. The species are, with two single exceptions, all Greenlandic. Spitzbergen, altogether to the south of these positions, contains under 100 flowering plants and ferns, though its west coast is washed by the Gulf Stream, and its shores have been diligently explored by many trained collectors. Its north coast has yielded fewer plants, and no less than 15 of the plants collected by the Expedition have not been found anywhere in Spitzbergen. Contrasted with Melville island, in latitude 75 degrees north, and Port Kennedy, in 72 degrees north, the contrast is even more striking, these well-hunted spots, both so much further south, yielding only 67 and 52 species respectively. This extension of the Greenland flora to so very high a latitude can only be accounted for by the influence of warm currents of air, or of the air being warmed by oceanic currents during some period of the summer; and we look with great interest to the meteorological observations made during the voyage, which are being discussed by Sir George Nares, who hopes to have it completed in a couple of months. The observations on the temperature of sea-water will, he expects, give new information; and great interest is attached to the study of certain warm gales and warm currents that were experienced in latitude 82 degrees and 83 degrees north. May not these phenomena of vegetation and temperature indicate the existence of large tracts of land clothed with vegetation in the interior of Greenland, far within the mountain ranges of its ice-clad coast, and protected by these from the heavier snow-falls, and hence for the accumulation of glacial ice that surrounds it on all sides? Professor Heer, of Zurich, has examined the fossil plants, the most important of which are those he states to be of miocene age. There are 25 identifiable species, of which all but one have been found also in Spitzbergen. This tracing the miocene flora so far to the northward was one of the principal scientific objects to be accomplished by the Polar expedition; and the fact that its character continues to be neither Polar nor Arctic, but temperate, supports the hypothesis that during the era in question a vegetation analogous to that now inhabiting the temperate latitudes entirely capped the North Polar area of the globe. Mr. Etheridge has worked at the very valuable collection of paleozoic fossils procured by Captain Fielden, and these, with the miocene and post pliocene fossils,

have thrown more light on the former conditions of the circumpolar regions than perhaps all those of previous expeditions.

Sir G. Nares has supplied to the President the following *résumé* of some of the principal meteorological results, and their comparison with those taken at Polaris bay in 1871-2:

	Mean Annual pressure.	Mean annual temperature.	Minimum temperature.
	Degrees.	Degrees.	Degrees.
Alert, Floeberg beach.....	29.869	—3.467	—73.75
Discovery, Discovery bay.....	29.887	—3.932	—70.8
Polaris bay.....	29.970	+4.196	—45.5

Minimum temperature of earth 20 inches beneath surface—13.0 degrees.

The warmer temperature at Floeburg beach was due to its exposure to the warm winter gales from which Discovery bay was cut off. The still warmer temperature of Polaris bay is partly attributable to there being some uncovered water in the neighborhood. The tidal observations have been entrusted to the Rev. Dr. Haughton, who hopes to present his results before the end of this session of the society. He has already arrived at the following general conclusions: 1, the tide which comes down Smith's sound from the north is generically distinct from the Behring's straits tide and from the Baffin's bay tide; 2, it must, therefore, be the East Greenland Atlantic tide, and consequently Greenland is an island; 3, this new tide contains a sensible tertiodiurnal component of much interest. The result of temperature examination was thus stated: Making due allowance for unavoidable sources of error, the temperatures of the sea observed on the west shores of Smith's sound prove the existence of a stratum of cold outer water (temperature about 29 degrees) lying between the locally heated surface-water and a depth of 20 to 30 fathoms, flowing southward in summer; as also of a warm underlying stratum of about 30 degrees. This latter was not found near Floeberg beach, but coupled with the 1872 observations of the Polaris, which showed a temperature of 32.8 degrees at 203 fathoms, in latitude 80 degrees 44 minutes north (midway between Franklin and Hall's islands, in Robison channel), and 32.1 degrees at 17 fathoms in Polaris bay, it would appear that the warm underlying water forces itself to the northward on the east side of Robison channel. Its entrance into the Polar sea or not will depend on the depth of water at the north end of the channel. They also prove the non-existence of a lower temperature of the water than 28.8 degrees at above a depth of 275 fathoms in Smith's sound or Baffin's bay. The coldest portion of the Arctic water appears not to affect that near Hayes sound or Discovery bay to so great an extent as that of the direct channel.—*London Times.*

Geographical News.—The *Bulletin de la Société de Geographie* for November contains commentaries on some old maps of New

Guinea, forming materials for a history of the discovery of this country by Spanish navigators from 1528 to 1606, with a map. M. Marche has returned from the west coast of Africa after exploring Upper Ogooné. M. Wiener has finished his explorations of the Andes. Mr. N. B. Wyse, member of the International Society of the Interoceanic Canal by the Isthmus of Darien, is now making a new exploration in this region.

Prof. Mohn, in Petermann's *Mittheilungen* for January, gives an original map of the relief of the sea-bed between the British Isles, Norway, Spitzbergen and Greenland. On this the contour lines of equal depths for each 100 fathoms are shown, and the grand feature of this region, the submarine barrier which passes from the north of the British Isles across by the Faröe islands and Iceland to Greenland, rises for the first time distinctly to view. It is this great barrier, says the *Academy*, that mainly determines the conditions of the deep seas on each side of it. The depth of the Atlantic on the south-western side are filled up with warmer water, but as soon as the barrier is crossed this is limited to the uppermost strata. On the Atlantic side of the ridge a mass of ice-cold water occupies the sea in its greatest depths, and is prevented by the barrier from penetrating into the depths of the Atlantic. Prof. Mohn also proposes that the sea between Norway and the Faröe islands, from Mayen and Spitzbergen, which has never been distinguished by any special name, be called the "Norwegian sea."

Gerhard Rohlfs is to undertake a new journey of exploration in the Eastern Sahara, which is planed to extend over five years.

MICROSCOPY.[1]

Bulloch's Microscopes. — Mr. W. H. Bulloch, 126 Clark street, Chicago, has issued a well illustrated description of his recent improvements in the construction of the microscope, in which appear several points of novelty and importance. The new large stand is literally full of ingenious contrivances, and without being clumsy or unduly complicated seems to combine more really useful adjustments than any other stand containing the modern improvements.

The sub-stage and mirror bar both swing around an axis in the plane of the object on the stage. Mr. Bulloch claims, with much reason, to have been the first to apply such an adjustment to the sub-stage, and he now mounts the mirror bar in a similar manner, the two being made to move either together or separately, and either by hand or with a mechanical motion; or the sub-stage with its milled heads can be entirely removed. Thus is attained a facility not hitherto equaled of using either sub-stage or mirror or both together at any angle below the stage

[1] This department is edited by Dr. R. H. Ward, Troy, N. Y.

or in any desirable position above it. The obliquity of illumination is indicated by graduated arcs. The sub-stage itself has centreing and rotating as well as vertical movement.

The fine adjustment has been removed to the same position as in Zentmayer's recent stands; but instead of a separate slide, the levers act upon the body by means of the rack itself, by moving steadily, up and down, the box in which the pinion of the coarse adjustment acts. This is forced upwards by a direct action, and downwards by a spiral spring. Great steadiness is attained, as well as the ordinary advantages of removing fine adjustment from the nose-piece. The nose-piece, however, is movable vertically, and has a safety spring as in the usual form of fine adjustment.

The stage is mounted on such a level that when the tube is placed vertically the axis around which the instrument rotates at the base will pass through the object on the stage, and consequently through the focal plane of the objective and of the illuminating apparatus, giving great advantage for optical experiments. The stage itself is sufficiently thin to admit an obliquity of illumination of 67 degrees without special appliances. It has graduated horizontal and vertical movements by means of a screw and a chain moved by milled heads upon the same axis; also a mechanical and graduated rotation around a centre which is easily adjustable to the axis of even a high power objective. It is also supplied with Brown's iris diaphragm. The iris diaphragm is furnished with the society screw so that it can be, if desired, either used in combination with an achromatic condenser, or used as an adapter above the objective itself so as to reduce directly the angle of light in the instrument.

Besides this superb instrument, Mr. Bulloch makes a smaller stand specially suited for diatom work, but well calculated for general use. It is nearly equal to the large stand in completeness and in everything but size, and has a stage (rotating but not mechanical) sufficiently thin to admit light at an obliquity of 73 degrees, and reversible so that the slide can be used on the under side with light at any desired angle up to 90 degrees. He also introduces several styles of small and low priced microscopes in which some of the most excellent and popular English and American stands are reproduced with ingenious additions and improvements.

These instruments are beautiful in form and of excellent workmanship, and they add another notable item to the recent valuable contributions of American workers in this department of science.

Microscopical Supplies.—Mr. Chas. Petit, of 151 High street, Stoke Newington, London, England, is sending cover glasses and other small supplies to this country promptly and at a low price. One ounce of thin circles are sent postpaid, for $1.25, or if thinner glass for $1.50. Two ounces of squares and circles mixed are

sent for $2, ground edged slips for $2 per gross, ornamental paper covers five hundred for $1, tin cells of any usual size and thickness for from 50 cents to $1 per gross, and glass cells at from $1 per gross upwards. One dozen and a half really good unmounted objects are furnished for $1.

MICROSCOPICAL SOIRÉE.—The Soirée given at the Agricultural and Geological Rooms, under the able direction of Professor Cox, in Indianapolis, on the 30th of January, was largely attended by the most cultivated citizens of the place. Microscopes by Zentmayer, Bulloch, Beck, Hartnack, Grunow and others were in use, and the exhibition was made instructive as well as entertaining. The opening address was made by Professor Cox, and the objects were shown and explained by the various microscopists of the city.

NEW YORK MICROSCOPICAL SOCIETY.—This new society completed its organization by the adoption of a constitution on the 21st of December last. It will meet on the first and third Friday evenings of each month. The officers for the present year are as follows: J. D. Hyatt, president; G. I. Whitehead, vice-president; A. J. Swan, 176 William street, corresponding secretary; R. Hitchcock, recording secretary; W. C. Hubbard, treasurer; D. B. Scott, librarian and acting curator.

NATURE CLUB OF ALBANY.—At the annual election, January 14th, 1878, the following officers were elected: Dr. George T. Stevens, president; Dr. Willis G. Tucker, vice-president; Richard Prescott, secretary.

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SCIENTIFIC NEWS.

— The occurrence of the hundredth anniversary of the death of Linnæus, on the 10th of January last, gave occasion to all the scientific societies and institutions in Sweden, and to several others abroad, to arrange festive meetings in celebration of the day. The Swedish papers of the succeeding days were full of descriptions of these feasts, and we give our readers a short account of one of them, which was held at the old University of Upsala, the venerable *Alma Mater* of Swedish science for more than 400 years.

At eight o'clock in the morning the bells of the cathedral proclaimed in solemn strokes that the University was going to celebrate the memorial of her greatest son. At half-past eleven the bell-ringing sounded again, calling out the members of consistorium academicum, invited guests, "the supporters and friends of science," and the 1500 students of the University, to proceed from the University to the grand hall of the College, which for this

occasion was profusely and tastefully decorated all around with fresh flowers and shields bearing inscriptions alluding to events in Linnæus's life. In the background was seen Linnæus's bust, mounted on a pedestal and crowned with a wreath of fresh laurel; it was surrounded with living Thuyas. Above this was seen Linnæus's coat of arms—in the centre a blue field with an egg (to illustrate his thesis "*Omne vivum ex ovo*"), and around this three fields, viz: one black, one green, and one red, representing the three kingdoms of nature, the mineral, the vegetal and the animal. These fields were surmounted by a helmet, out of which two cactus leaves protruded. A garland of *Linnæa borealis* was twisted round the whole crest. Opposite the background was seen, on the organ gallery, a ribbon with his motto, "*Innocue vivito, Numen adest.*" A considerable number of ladies in gala dresses added to the festive appearance of the hall. The chancellor of the University, Count H. Hamilton, the Archbishop, the Governor of Upland, the rector Manificus, and the prorector of the University had their seats next to the tribune. Next to them appeared some descendants of Linnæus, among them Dr. Tycho Tullberg, the zoölogist. The whole auditorium numbered about 1000.

The programme began with a cantata by Prof. Josephson, with words by Prof. Fr. Holmgren, of which elegantly printed copies were distributed among the auditors. Botanicus Professor Th. M. Fries then mounted the tribune and read the oration, in which he, with his usual eloquence and spirit, gave a sketch of Linnæus's immortal works as naturalist, physician and academical teacher, as well as of his private life. He pointed out how Linnæus's great genius was so much ahead of his time that many of the greatest questions of our days were already conceived by him, although not understood by his contemporaries and therefore forgotten, until in our days they have been taken up again. Even the theory of evolution was the object of his meditations, as has been proved in a newly recovered manuscript on this subject, where he called the monkeys "the cousins of man."

Humbolt has been called the originator of the geography of plants; to Goethe has been attributed the origin of the theory of metamorphoses in plants; but both were preceded by Linnæus, who in some of his works treated both those branches of botany. As mineralogist he proved to be far ahead of his time through his crystallographic discoveries. As physician he distinguished himself not only as a successful practitioner, but also as the author of many important medical papers e. gr. "Genera morborum," "Materia medica." He proved the value of applying electricity in certain cures. He pointed out the influence of certain microscopic organisms on the human body, etc. His genius and energy enabled him to complete an enormous amount of work. Only his private correspondence would have been enough

for a man of less enormous capacity, and still nearly every letter of his is a scientific treatise of great value. It is well known how he once was cured from podagra by the arrival of Kalm's large collections from North America. To him the natural history was a "gaia scienzia," and it was at the same time a form of devotion to the Creator, free from all selfishness. He regarded himself as pontifex in the temple of Nature. "I have," so he says in his preface to Systema Naturæ, "I have seen the eternal, infinite, omniscient, omnipotent God. I have seen Him and been dumb with astonishment."

In the Royal Academy of Science in Stockholm, was gathered the same evening, an illustrious assembly of all that the Swedish capital has eminent in science. This Academy was founded by Linnæus and his friends. The festival oration was read by General Wede, the Præses of the Academy. King OSCAR read a telegraphic greeting in Latin from the German Academy of Science in Frankford on Main, and also his answer in the same language. Before the meeting was dissolved, the academy decreed an appropriation to a great-grand-daughter and a great-great-grand-daughter of Linnæus, both living in rather indigent circumstances.

To the great number of busts, medals and portraits of Linnæus, previously existing, have on this occasion been added a well executed copy of the portrait of Linnæus, at the age of 67, painted by Roslin, and a new medal by Mrs. Lea Ahlborn. The large statue of Linnæus for which contributions have been collected all over the country, on the invitation of the Academy of Science, had not yet been completed.—*J. Lindahl.*

— It is proposed to issue by subscription a catalogue of scientific serial publications in all languages, which has been prepared by Mr. Samuel H. Scudder, librarian of the American Academy of Arts and Sciences, and formerly librarian of the Boston Society of Natural History.

This work, which has double the extent of any existing list of the like kind, aims to include all transactions of societies and independent journals in every branch of natural, mathematical and physical science, excepting only the applied sciences—medicine, agriculture, technology, etc. The different institutions or periodicals are arranged under the towns in which they are established or published, and the towns follow an alphabetical order under their respective countries. Cross references are given wherever desirable. It will be printed in octavo, will extend to almost 300 pages, and will be delivered, bound in cloth, to subscribers at four dollars the copy. Other copies will be printed on one side of the leaf, to be cut up for catalogue use, and will be delivered in folded sheets at five dollars the copy.

Intending subscribers may address Justin Winsor, librarian of Harvard College, Cambridge, Mass.

— A third session of the Summer School of Biology of the Peabody Academy of Science, Salem, Mass., will open July 5th, and continue six weeks. Those desiring information regarding the course of instruction, etc., may apply to A. S. Packard, Jr., Director of the Peabody Academy of Science, Salem, Mass.

— An important work has just been issued by Hayden's U. S. Geological Survey of the Territories, entitled Contributions to the Fossil Flora of the Western Territories. Part II. By Leo Lesquereux, Washington, 1878. It forms Volume VII, of the quarto reports of Professor Hayden's Survey, and is a bulky volume of 366 pages and 65 plates. It is divided into three parts, of which the first treats of the Areal Distribution, the Stratigraphy of the Lignitic Formation, and its capacity for combustible mineral, and third, the age of the Lignitic, indicated by its Geological Distribution and its Fauna. The second Part contains the Descriptions of the Tertiary Fossil Plants, while the third comprises the following subjects: The Age of the Lignitic Formations determined by the characters of the Fossil Plants; a Table of the Distribution of Species, and a Table of the Distribution of the species of the Point of Rocks.

— Two distinguished entomologists have just been removed by death: T. Vernon Wallaston, born March 9, 1821, died in England suddenly, January 4th ult. He will be remembered for his elaborate work entitled *Insecta Maderensia*, and his little work On the Variations of Species, published in 1856.

Andrew Murray, born February 19, 1812, died in London, January 10th, 1878. His quarto volume on the geographical distribution of mammals, his monograph of the beetles of the *Sphæridiidæ*, and of the genera Cercyon and Catops, and his papers on the geographical distribution of beetles, are monuments to his memory.

Henry Lawson, M.D., died at Cork, October 4th. He was for many years the editor of the *Popular Science Review*, and conducted the *Monthly Microscopical Journal* from its commencement till his death, which has caused its discontinuance.

L. Pfeiffer died at Cassel, aged 72. His Nomenclator Botanicus was the most useful of his laborious compilations.

— One of the most important contributions to our knowledge of the marine fauna of the subarctic regions, is the famous Fauna Littoralis Norvegiæ, the second part of which appeared in 1856. The third part has lately been received in this country. It is a folio volume with sixteen plates, published at Bergen, in 1877, from an appropriation of 4000 crowns made by the National Assembly of Norway. The contents comprise the following chapters: New and little known Cœlenterates; New Echinoderms, by the late Michael Sars. The remaining chapters are by Professor

Koren and Dr. Danielssen, on the following subjects: Description of some new Norwegian Cœlenterates, Contributions to the Natural History of the Pennatulidæ living on the Norwegian coast; Description of new Bryozoa; Contributions to the Natural History of the Norwegian Gephyreæ. A new species of the genus Penella. Some of the plates are colored, and many anatomical details are given, making this part worthy of its distinguished predecessors.

— Dr. Peterman, of Gotha, in his "Geographical Notes" for November, calls Henry M. Stanley "the Bismarck of African exploration." As Bismarck united the various German principalities into one great empire, so Stanley, taking all previous African discoveries, scattered as they were and mixed up with conjectures, "with one masterly stroke united all these *disjecta membra*, wove the odds and ends of previous researches and efforts for thousands of years into one compact, valuable web." Thus he thinks that Stanley's work is unparalleled in the whole history of discovery in the world; and he proceeds to sustain the opinion by showing how Stanley transcended all that was previously known respecting the Congo river. This is lofty praise, but it comes from one whose competency to give it has never been questioned.

— Dr. Jared P. Kirtland, who died at East Rockport, Ohio, was a native of Wallingford, Ct., and was well known in this country for his attainments in natural history, and especially discoveries in conchology and ichthyology. In 1848 he was given charge of the natural history department in the survey of Ohio, and his works on the subject were published in Boston and elsewhere in the East. Important degrees were bestowed upon him by various Eastern and Western colleges, and honors were given by several societies for valuable scientific services. He was 84 years old at the time of his death.

— A letter just received from Prof. J. Schoetter, Secretary General of the "Congrès International des Américanistes," states that one volume of the proceedings of the interesting and successful meeting, held at Luxembourg on the 10–13 of September, 1877, would be issued about the first week of December. The second about the last of February, 1878. The next session will be held at Brussels in 1879, instead of in this country, as was at one time proposed.—*E. A. Barber.*

— The American Museum of Natural History in Manhattan Square, at Seventy-seventh street and Eighth avenue, was opened to the public December 22d, by President Hayes. It is a high, red brick building, with modified English-Gothic windows.

An eloquent address was delivered by President Elliott, of Harvard College, in which he is reported to have said:

"We are assembled here to view with gratitude the beneficent

power of natural science, to praise and thank its votaries, and to dedicate this splendid structure to its service. The power to which we do homage is the accumulated intelligence of our race applied, generation after generation, to the study of nature, and this palace is the storehouse of the elaborated materials which that intelligence has garnered, ordered and illuminated. What has natural science done for mankind that it should be thus honored? Natural science has engendered a peculiar kind of human mind. The searching, open, humble mind, which, knowing that it cannot attain unto all truth, or even to much new truth, is yet patiently and enthusiastically devoted to the pursuit of such little new truth as is within its grasp, having no other end than to learn, prizing, above all things, accuracy, thoroughness and candor in research, proud and happy, not in its own strength, but in the might of that host of students whose past conquests make up the wondrous sum of present knowledge, whose sure future triumphs each humblest worker in imagination shares. It has been reserved for natural science in this generation to demonstrate the universality of hereditary transmission and its controlling influence upon the families, nations and races of men, as well as upon all lower orders of animate beings. It is fitting that natural history should have given this demonstration to the world, for the basis of systematic natural history is the idea of species, and the idea of species is itself founded upon the sureness of hereditary transmission upon the ultimate fact that individual characteristics are hereditable. As the knowledge of heredity recently acquired by science permeates society it will profoundly affect social customs, public legislation and governmental action. It will throw additional safeguards around the domestic relations, enhance the natural interest in vigorous family stocks, guide wisely the charitable action of the community, give a rational basis for penal legislation, and promote both the occasional production of illustrious men and the gradual improvement of the masses of mankind. These moral benefits will surely flow from our generation's study of heredity. Modern science has exalted the idea of God, the greatest service which can be rendered to humanity." After Prof. Marsh, President of the American Association for the Advancement of Science, had delivered a brief address, President Hayes was introduced by President Stuart. The President said: "Mr. President, Ladies and Gentlemen—Without introduction I now perform the honorable but brief and simple duty assigned to me at the opening of this enterprise, so noble, so valuable and so splendid, which the country owes to the enlightened liberty of the city and the citizens of New York. And I now declare that the opening ceremonies have been completed; that the American Museum of Natural History is now open."

The building has been built by the city of New York, while the fine collections in it have been purchased by private subscrip-

tions. Each hall is 170 feet long by 60 wide, inside the walls. The lowest story is 18 feet high; the second, or principal story, including the gallery is 30 feet; the upper story 22 feet, and the Mansard story 16 feet in height.

— On the 21st of May, 1877, fourteen carp, only three of which were old enough to spawn this season, were placed in a pond near the residence of Henry Parsons, three miles from this city. On the 10th of October, following, the pond was drawn off, and the original fourteen carp, much grown and in a fine condition and healthy, together with their increase of 1408 young and vigorous fish, were taken out and placed in a breeding pond for next year.

— A Sea Lion and Sturgeon in Combat. In San Francisco bay the angler sometimes hooks a salmon that has had a piece bitten out of the shoulder by the rapacious seal, and certainly the seal lives by masticating fish in whole or part. Recently the passengers on the 10 o'clock, A. M. boat from Oakland, witnessed a tough fight between a sturgeon and a sea lion. The seal bit viciously at the gill openings of its adversary, and showed superior finesse in planning the campaign, while the sturgeon lashed the water powerfully with its unequally lobed tail, and occasionally administered a stunning blow to the seal. Blood flowed profusely and the water was dyed for yards around, but eventually the sturgeon yielded up the ghost, being seized unluckily by the tail and paralyzed in movement by having its only propeller nearly bitten off. Thus wounded and circumvented, it speedily desisted from the battle, and the seal administered the *coup de grace*, and towed his dinner beneath the waves. The spectacle was an exciting one.—*San Francisco Paper.*

— A new species of Chimæra has recently been captured on the Banks. This is the first occasion of this interesting fish so low down the American coast, though a species occurs in British waters.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

California Academy of Sciences, December 17th.—Dr. H. Behr read an interesting paper giving the results of his experiments on the resistance of some species of Eucalyptus to ignition. Whether all the Eucalypti share in this peculiar power of resisting fire, has not been ascertained. His observations had been chiefly directed to the *Eucalyptus rostrata* in Australia, where he had often seen it flourishing in burnt tracts where every other tree had been consumed. He attributed this peculiar property of the

wood chiefly to its physiological structure and chemical composition rather than to its vitality.

A general discussion on the Eucalypti followed, in which several members stated that some species of that tree had been found impervious to the attacks of frost as well as heat.

The concluding paper of the evening—on the "Necessity of a Physical Survey of California"—was read by Prof. Davidson. He believed that such a survey was of the utmost importance to the State, and enumerated the advantages that would be equally gained by the farmers, manufacturers and capitalists, from a perfect map illustrating accurately the physical, geographical and geological features of every part of the State. Such a map, he believed, would be of the greatest service for the reclamation of swamp lands, to understand the hydraulics of the Sacramento Valley, to open new avenues of travel and transportation, and to afford valuable information for all the industries. Another important reason why the State should undertake such a work was the fact that the whole system of maps and land surveys adopted by the United States Government is a delusion, and any one who has examined this subject will find them to be full of the most glaring errors and inaccuracies. At another meeting, Dr. A. Kellogg described a new species of "hog peanut" vine named by him *Amphicarpea arizonica;* and a paper by President John Le Conte, of the University of California, on "Mars and his Moons," was read by Mr. S. B. Christy. Mr. Hollister presented to the Academy a specimen of Japanese persimmon, grown in Mr. Hollister's orchard at Santa Barbara. In Japan, it is said, as many varieties are grown as of the apple here, and the sweetness of the fruit is always retained.

He remarked, "The fruit is, I think, the most beautiful of all the fruits I have ever seen, and is the most delicious to the taste. I carried four of them to San Francisco last fall, which weighed three-quarters of a pound each. The fruit is a rich yellow color, and seems more like a ball of wax than a fruit. It is simply splendid. I think it will be the greatest acquisition to our State ever introduced.

"This variety, known as the *Diospyros kaki*, differs materially from the wild persimmon of the Southern States, as it ripens without frost, and is equally palatable whether fresh or dried. The tree is highly ornamental, a prolific bearer, and as hardy as the pear. Its season is from October to March, coming in when fine fruits are scarce. The fruit is of a bright yellow, orange or reddish color, and is pronounced equal to the pear or peach. It is also sufficiently solid to be packed and shipped with safety. It grows to a large size, attaining in some cases a pound each in weight.

"The Japanese persimmon is perfectly adapted to the soil and climate of this country, and may be cultivated precisely as the

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

California Academy of Sciences, December 17th.—Dr. H. Behr read an interesting paper giving the results of his experiments on the resistance of some species of Eucalyptus to ignition. Whether all the Eucalypti share in this peculiar power of resisting fire, has not been ascertained. His observations had been chiefly directed to the *Eucalyptus rostrata* in Australia, where he had often seen it flourishing in burnt tracts where every other tree had been consumed. He attributed this peculiar property of the

wood chiefly to its physiological structure and chemical composition rather than to its vitality.

A general discussion on the Eucalypti followed, in which several members stated that some species of that tree had been found impervious to the attacks of frost as well as heat.

The concluding paper of the evening—on the "Necessity of a Physical Survey of California"—was read by Prof. Davidson. He believed that such a survey was of the utmost importance to the State, and enumerated the advantages that would be equally gained by the farmers, manufacturers and capitalists, from a perfect map illustrating accurately the physical, geographical and geological features of every part of the State. Such a map, he believed, would be of the greatest service for the reclamation of swamp lands, to understand the hydraulics of the Sacramento Valley, to open new avenues of travel and transportation, and to afford valuable information for all the industries. Another important reason why the State should undertake such a work was the fact that the whole system of maps and land surveys adopted by the United States Government is a delusion, and any one who has examined this subject will find them to be full of the most glaring errors and inaccuracies. At another meeting, Dr. A. Kellogg described a new species of "hog peanut" vine named by him *Amphicarpea arizonica;* and a paper by President John Le Conte, of the University of California, on "Mars and his Moons," was read by Mr. S. B. Christy. Mr. Hollister presented to the Academy a specimen of Japanese persimmon, grown in Mr. Hollister's orchard at Santa Barbara. In Japan, it is said, as many varieties are grown as of the apple here, and the sweetness of the fruit is always retained.

He remarked, "The fruit is, I think, the most beautiful of all the fruits I have ever seen, and is the most delicious to the taste. I carried four of them to San Francisco last fall, which weighed three-quarters of a pound each. The fruit is a rich yellow color, and seems more like a ball of wax than a fruit. It is simply splendid. I think it will be the greatest acquisition to our State ever introduced.

"This variety, known as the *Diospyros kaki*, differs materially from the wild persimmon of the Southern States, as it ripens without frost, and is equally palatable whether fresh or dried. The tree is highly ornamental, a prolific bearer, and as hardy as the pear. Its season is from October to March, coming in when fine fruits are scarce. The fruit is of a bright yellow, orange or reddish color, and is pronounced equal to the pear or peach. It is also sufficiently solid to be packed and shipped with safety. It grows to a large size, attaining in some cases a pound each in weight.

"The Japanese persimmon is perfectly adapted to the soil and climate of this country, and may be cultivated precisely as the

apple. The grafted trees bear in about four years, seedlings require double that time and are not reliable."

American Geographical Society.—January 31st. The members received the Earl of Dufferin, Governor-General of Canada, and then considered Capt. H. W. Howgate's plan for the exploration of the Arctic regions. Addresses were delivered by Capt. Howgate, Mr. W. C. Bryant, Mr. Bayard Taylor, Hon. I. I. Hayes and Chief-Justice Daly, President of the Society.

Appalachian Mountain Club.—February 13th. Papers were read on the Mt. Desert Hills, by Rev. J. C. Adams, and on Roan Mountain, North Carolina, by Prof. J. H. Huntington.

Boston Society of Natural History.—January 16th. Mr. G. W. Bond made a communication on the Origin of the Merino race of sheep.

American Academy of Arts and Sciences.—February 13th. Prof. B. G. Wilder read a paper on the ærial respiration of Amia.

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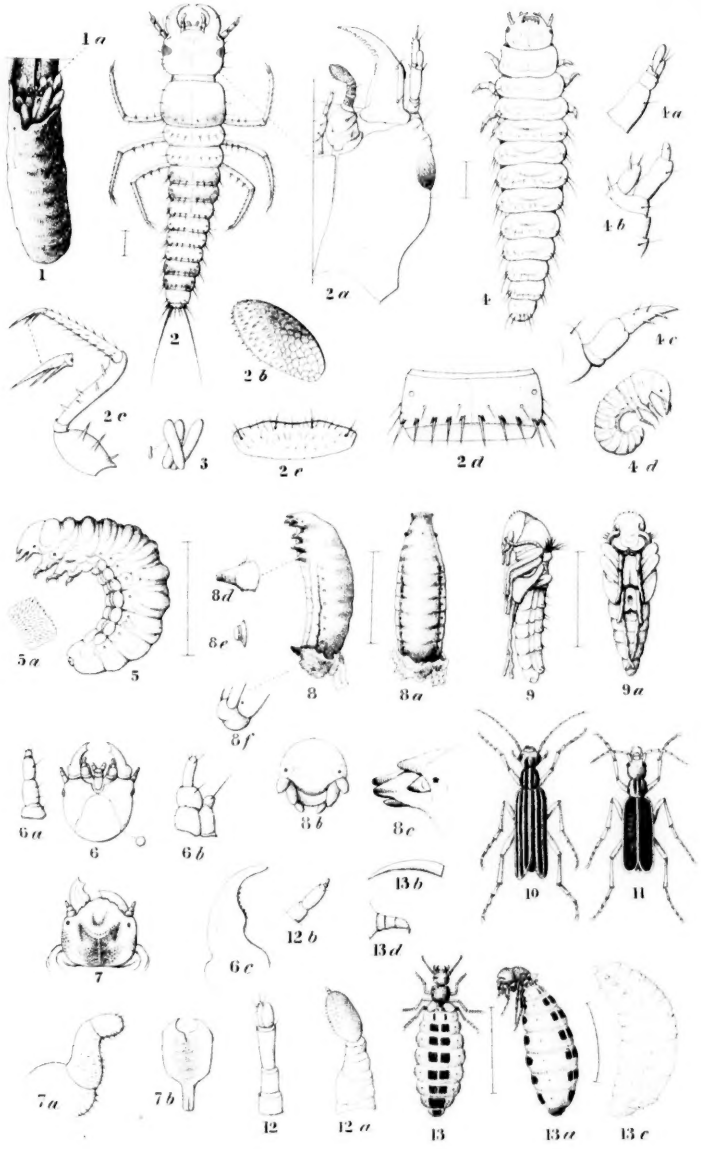
SCIENTIFIC SERIALS.[1]

The Geographical Magazine.—January. Language-map of the East Indies, by R. Cust. The north-western frontier of India. The still unexplored parts of South America, by C. R. Markham. The ancient silk-traders' route across central Asia. Affairs in Japan, by R. H. Brunton.

American Journal of Science.—February. Echinoid fauna of Brazil, by R. Rathbun. Poplars of North America, by S. Watson.

Annales des Sciences Naturelles.—December 31, 1877. Mémoire sur l'Embryologie des Némertes, par J. Barrois. Expériences sur le Developpement rubanaire du Cysticergne l'homme, par M. Redon.

[1] The articles quoted here are, in some cases, selected.



C.V. Riley, del

Hypermetamorphoses of Epicauta and Hornia.

EXPLANATION OF PLATE I.

All the figures enlarged unless otherwise stated, the hair-lines indicating the natural sizes.

FIG. 1.—Egg-pod of *Caloptenus differentialis* with the mouth torn open, exposing the newly-hatched larva of *Epicauta vittata* (1 *a*) eating into an egg, and the passage which it made through the mucous covering—natural size.

FIG. 2.—Dorsal view of the first larva, or triungulin, of *E. vittata;* 2 *a*, one side of the head of same from beneath, greatly enlarged so as to show the mouth parts; 2 *b*, terminal joint of maxillary palpus showing imbrications and flattened inner surface armed with stout points; 2*c*, leg, showing more plainly the tarsal spines; 2 *c*, labrum; 2 *d*, one of the abdominal joints from above, showing stout points, stigmata and arrangement of spinous hairs.

FIG. 3.—Eggs of *E. vittata*, the natural size indicated at side.

FIG. 4.—Dorsal view of the Carabidoid stage of the *Second Larva* of *E. vittata;* 4 *a*, its antenna; 4*b*, its right maxilla; 4 *c*, its leg; 4 *d*, side view of same, showing its natural position within the locust-egg mass.

FIG. 5.—Lateral view of the ultimate or full-grown stage of the *Second Larva* of *E. vittata;* 5 *a*, portion of the dorsal skin, showing short setaceous hairs.

FIG. 6.—Third head, or that from the Scarabæidoid stage of the *Second Larva* of *E. vittata*, from beneath, showing the reduction of mouth-parts as compared with the first head (2 *a*); 6*a*, antenna of same; 6 *b*, maxilla of same; 6 *c*, mandibles of same.

FIG. 7.—Fourth head, or that of the full-grown larva of *E. vittata*, from above; 7 *a*, leg of same; 7 *b*, the breast-plate or prosternal corneous piece.

FIG. 8.—Lateral view of the pseudo-pupa or *Coarctate Larva* of *E. vittata*, with the partially shed skin adhering behind; 8 *a*, dorsal view of same; 8 *b* its head from the front; 8 *c*, same from side; 8 *d*, tuberculous leg; 8 *e*, raised spiracle; 8 *f*, anal part of same.

FIG. 9.—Lateral view of the true pupa of *Epicauta cinerea* Forst.; 9 *a*, ventral view of same.

FIG. 10.—*Epicauta vittata* (*lemniscata* or trivittate var.).

FIG. 11.—*Epicauta cinerea* Forst (= *marginata* Fabr.).

FIG. 12.—Antenna of the triungulin of *Epicauta pensylvanica;* 12 *a*, maxilla of same; 12 *b*, labial palpus of same.

FIG. 13.—♂ *Hornia minutipennis*, dorsal view, 13 *a*, lateral view of same; 13 *b*, simple claw of same; 13 *c*, *Coarctate Larva;* 13 *d*, leg of ultimate stage of *Second Larva*.